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POWER

With Which Are Consolidated
The Engineer and the *Stationary Engineer*

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Moments with the Ad Editor

The Annual

POWER PLANT DESIGN NUMBER

will be published

May 18, 1926

POWER

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How Much Are You Losing?

I HAD a friend who used to say, "When a man is losing money and does not know it, it does not worry him."

He got a good deal of credit and reputation and some money by making one see, occasionally, that he was losing, and get worried about it.

All over the country there are antiquated power plants, wasting tons of coal per year under boilers that should have been scrapped long ago and wasting steam and heat in all sorts of ways.

Some of the men in charge of these plants are keenly sensible of the fact that they are losing money every day that they run. They can see that modern apparatus, wisely selected with reference to their conditions, would pay a big dividend on the cost of its installation.

But they are unable to convince their superiors of that fact.

Some have tried and failed to get interested attention; some have not dared or thought it worth while to try.

But some have known so well what could be done and have been able to present it so convincingly that they have set the boss to thinking, and have made themselves more than just "hands" in his estimation.

Perhaps they have even been charged with carrying out their recommendations.

There has been remarkable progress in power-plant processes and machinery in the past quarter century. Comparatively few owners and managers realize how much they could save by taking advantage of such improvements.

The price of fuel has been constantly going up and will continue to go up. Its saving is more and more of an object.

Talk it over with your engineer, and if he does not know what his present costs are and how and to what extent they could be reduced, call in somebody who can find out.

Perhaps you are losing money and don't know it.

F. R. Low

New Des Moines Power Station

Initial Two-Unit Installation Designed for Ultimate Capacity of 166,200 Kva.—Large Underwater Storage for Iowa Coal—Steam Conditions 385 Lb. Gage and 695 Deg. F.—Boilers Equipped with Forced-Draft Chain Grates, Economizers, Air Heaters and Evaporators—Stage Bleeding from Main Units and Motor-Driven Auxiliaries, Starting at Full Voltage

LOCATED southeast of the city on the Des Moines River about seven miles below the junction of that stream with the Raccoon River, the new power plant of the Des Moines Electric Co. was necessitated by the rapidly growing load of this company, which has more than doubled in the past five years. Prior to the completion of the new station, the Center Street plant, with an installed generating capacity of 25,000 kw., was the company's sole source of electric power. This is now maintained as a reserve.

Des Moines is about 50 miles from the southern Iowa coal fields, from which the coal supply for the new station is obtained. An average sample of this coal shows 9,084 B.t.u., 15 per cent moisture, 31 per cent volatile, 36 per cent fixed carbon, 18 per cent ash and 4 per cent sulphur. Iowa coal is likely to fire when stored in piles for longer than three weeks, and it has been necessary to provide under-water storage for the emergency fuel supply. Consequently a 50,000-ton concrete coal-storage area divided into three compartments is located on the west side of the plant. Of this capacity, 38,000 tons may be submerged in water.

Shipment of coal into the plant is made entirely by rail, as the river is not navigable. Coal is received in hopper bottom cars, which are weighed on a track scale before being dumped into twin track hoppers, from which a belt conveyor carries the coal to the breaker house. Tailings from the breaker, which may be bypassed, are handled over a picking belt and returned to the breaker, so that foreign material passes through repeatedly until picked off by hand.

At the breaker house two chutes are provided that will permit the coal either to be fed into the breaker or to be sent to storage by means of a conveyor. If slack coal is being handled, it may be diverted from the breaker direct to the conveyor running to the boiler room. Coal that is taken to storage is discharged into an initial storage pile adjacent to the breaker building. A drag line scraper then distributes it from the initial storage pile to the main concrete storage pit. When removing coal from storage, the drag line scraper hauls the coal back to the initial storage pile, beneath which there is a hopper 12 ft. square. From this hopper crushed coal is taken directly to the boiler house by means of a conveyor, whereas mine-run coal is first sent through the breaker, then to the boiler house.

By means of a series of belt conveyors, broken coal is carried up to the coal bunkers, which extend the length of the boiler room. Six boilers are fed by a bunker capacity of 1,200 tons. After the coal leaves the bunker it passes by gravity into automatic weighing hopper scales, of which there are two per boiler. From the scales coal chutes and spout swingers distribute the coal into the stoker hoppers.

At the time the plant was designed a complete investigation was made to determine whether stokers or pulverized fuel should be installed. Tests disclosed the fact that Iowa screenings took up 11 per cent moisture when stored under water for 48 hours, resulting in a total moisture content of about 28 per cent. To pulverize this fuel, it would have been necessary to install special apparatus for drying to reduce the moisture. This was one of the principal reasons that led to the decision to install stokers.

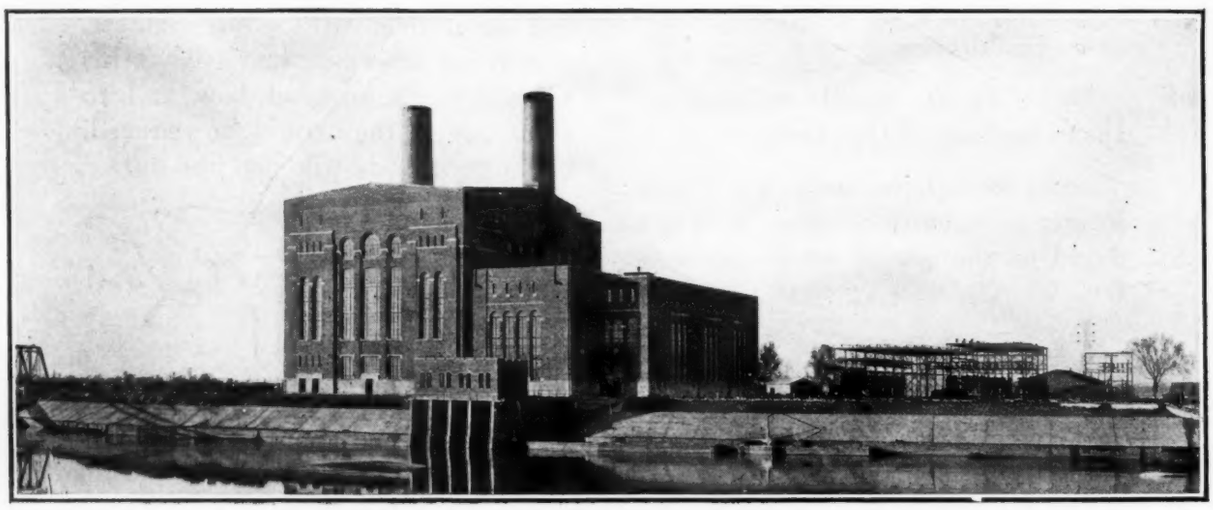
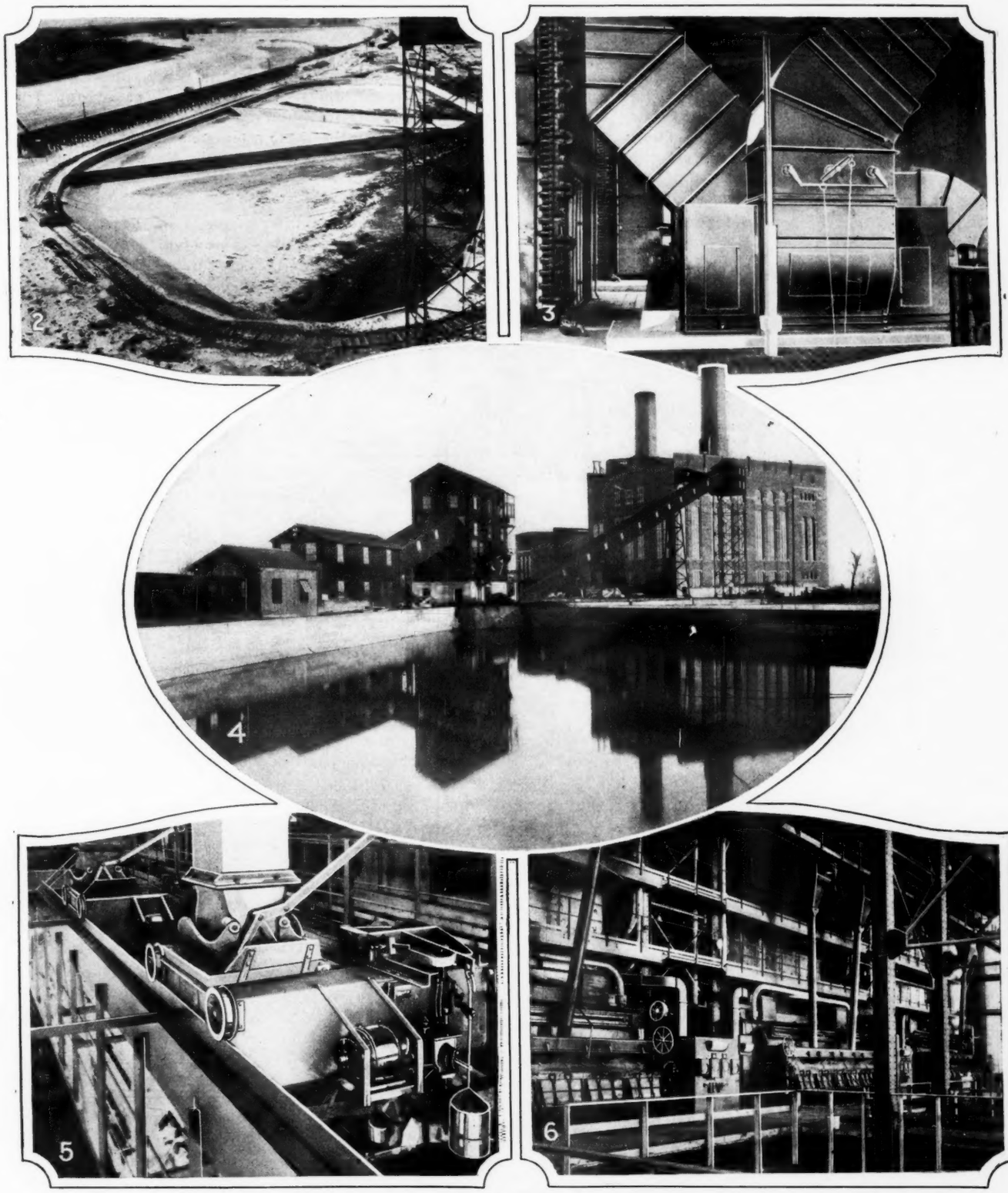


Fig. 1—New Des Moines plant as viewed from river, showing intake and discharge tunnels



Random Views of Des Moines Station

Fig. 2—Coal pit, tail car and tracks as viewed from economizer floor
Fig. 3—Induced and forced-draft fans on economizer floor
Fig. 4—Under-water coal storage and coal-handling equipment
Fig. 5—After the coal leaves the bunker it falls through automatic hopper scales
Fig. 6—The boilers are fired by forced-draft, chain-grate stokers

The station is being built in sections. In the initial section are two turbo-generators with capacities of 25,000 and 35,000 kva. respectively, together with five 15,018-sq.ft. cross-drum boilers. Three additional 35,300-kva. turbines will be added in the future, making a total ultimate generating capacity of 166,200 kva. No house turbine is provided, but precautions were taken to furnish means for starting up the station by installing steam-driven pumps sufficient to take care of such an emergency if a shutdown occurred.

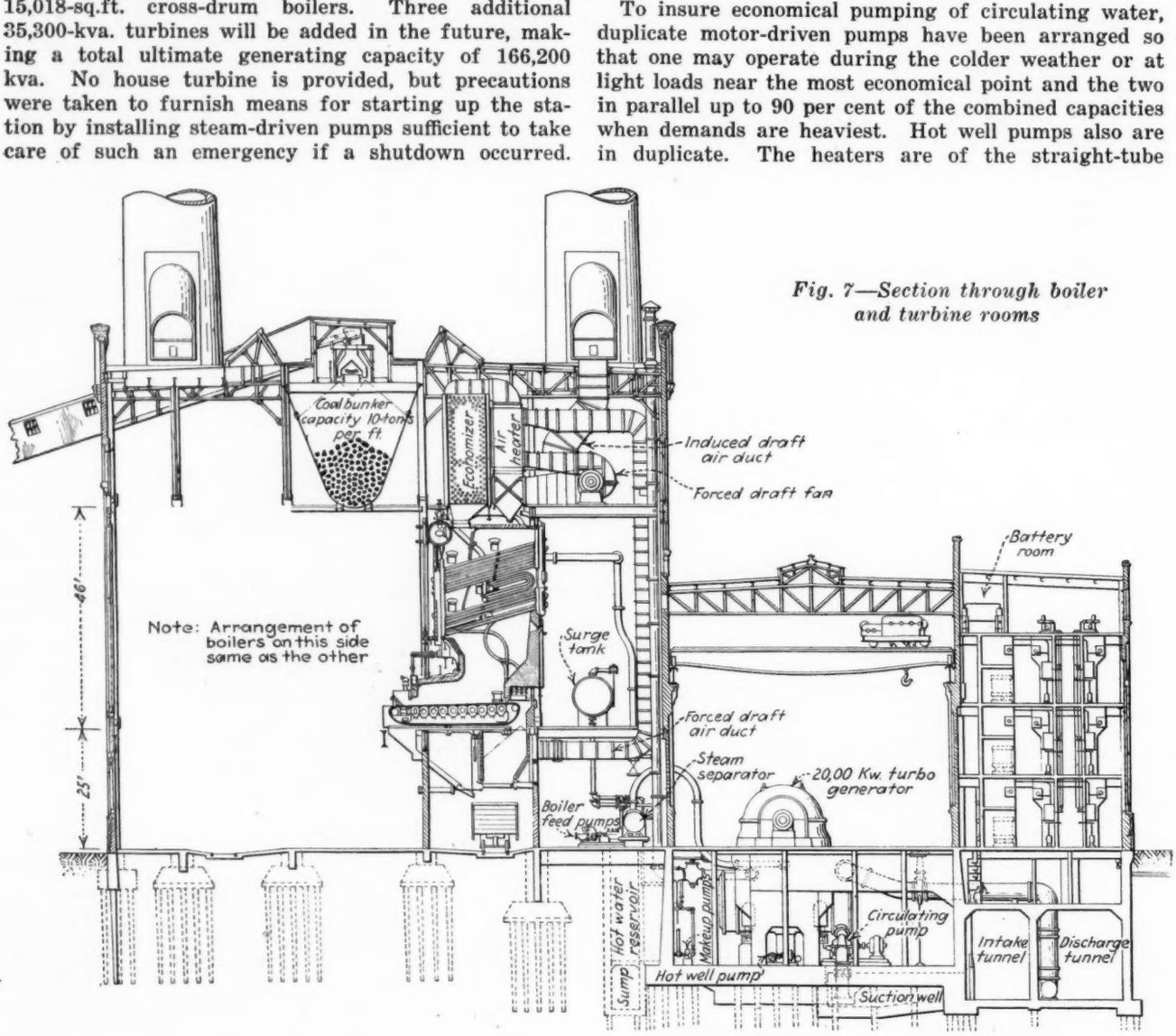


Fig. 7—Section through boiler and turbine rooms

Both turbines now installed are designed to operate at a throttle pressure of 350 lb., an initial steam temperature of 700 deg. F. and a speed of 1,800 r.p.m.

Provision is made for bleeding each turbine at three points, inasmuch as the heat balance in the plant is obtained almost exclusively from steam bled from the main units, and by using motor driven auxiliaries. The main generators have closed-circuit ventilation and cooling systems. The coolers are of the fin-tube type, consisting of a main cooler supplied with condensate and an auxiliary cooler supplied with house-service water and controlled by means of a valve actuated by a thermostat installed in the generator ventilating system.

Main condensers of the two-pass cylindrical type are equipped for de-aërating the make-up water returning from storage. This water is introduced through the shell on the air cooler side with an arrangement to film it out down the side of the condenser. The condensers are bolted directly to the turbine exhaust flanges and have spring supports to carry much of the weight. Two two-stage evactors, one for service and one for stand-by, each with inter and after coolers, are provided as vacuum pumps for air removal.

To insure economical pumping of circulating water, duplicate motor-driven pumps have been arranged so that one may operate during the colder weather or at light loads near the most economical point and the two in parallel up to 90 per cent of the combined capacities when demands are heaviest. Hot well pumps also are in duplicate. The heaters are of the straight-tube four-pass type, with one tube sheet mounted in a floating head to care for expansion.

Two rows of boilers with a central firing aisle express the general layout. Three of the boilers are 41 tubes wide by 17 tubes high, the tubes being arranged in two decks with an interdeck superheater above the lower six rows. The two lower rows are staggered to cool the ash below the slagging temperature before striking the upper tubes. Superheaters of the three-pass convection type are installed in the first pass. Protection is afforded by a 4-in. relief valve at the outlet set at a pressure of 379 lb. gage. On the boiler drum are five relief valves of the same size set at pressures ranging from 381 to 391 lb. gage. The center of the drum is 40 ft. above the boiler-room floor. Each boiler is fitted with two water columns and a feedwater regulator with a bypass arrangement.

With certain exceptions in tube arrangement and size, the other two boilers are much the same. They are 45 tubes wide by 20 tubes high, with four rows of tubes in the first deck. The tubes are expanded into

30 sectional forged-steel seamless vertical headers disposing them in staggered positions.

Each boiler has its economizer of the horizontal steel-tube, counterflow type, designed for 500 lb. working pressure. Three of the boilers have plate-type air heaters after the economizers, and space has been provided for future installation of air heaters on the two other units. A forced-draft fan for each boiler, located on the economizer floor, takes the warm air from the top of the boiler room and forces it through the air heater down to the stoker wind box. These fans are driven by wound-rotor motors with control at the fan and at the boiler panel. Brush-shifting motors drive the induced-draft fans.

Forced-Draft Stokers and Furnaces

To burn the inferior Iowa coal, forced-draft chain grates of the large size indicated by a ratio to the heating surface of 1 to 34 were selected. A feature insuring proper air distribution is the damper control. The front or first tuyere compartment of the stoker has an independent damper control on each side of the stoker. The second tuyere has a similar arrangement. The third, fourth and fifth tuyere dampers are actuated by one control, and this is true also for the sixth and seventh tuyere dampers, but the eighth, ninth and tenth tuyere dampers have independent controls.

Each grate is made of two chains on individual drive shafts at the front of the stoker, which are chain driven from a line shaft belt connected to a synchronous-speed brush-shifting motor. By changing the position of the brushes on the commutator, a speed range of from 1,800 to 585 r.p.m. at full load may be obtained.

To provide combustion space for the high-volatile Iowa coal a furnace volume of 0.41 cu.ft. per square foot of heating surface was provided. The ignition and combustion arches are set respectively 16 and 60 in. above the grate. The latter has an overhang of 9 ft. to insure proper ignition of a coal containing 15 per cent moisture.

A plenum box is provided at the front of the furnace to receive air from the stoker wind boxes for distribution in the furnace under the front of the combustion arch. Air admitted in this manner, under conditions of fairly high ratings, performs a useful scrubbing action of the gases, thoroughly mixing and bringing them in intimate contact with oxygen. Breaking up the stream flow of the gases through the furnace results in more uniform CO_2 throughout the setting.

Fin-tube furnace side-wall screens are connected to the boiler circulating system and installed behind the arch, on each side of the furnace, in the path of the upgoing gases. The effect is to decrease the furnace temperature about 200 deg. F. at 225 per cent rating, with a resultant decrease of 50 deg. F. in the uptake temperature of the gases leaving the boiler.

Heat Balance and Water Supply

The plant is operated on the regenerative cycle, make-up water for the boilers being supplied from an evaporator. Each of the main turbines is provided with three bleeder points to supply an evaporator and two heaters. The condensate from each main unit passes consecutively through the generator air cooler, the evactor inter and after cooler, the heat exchanger, the two-stage heaters, the boiler-feed pump suction headers, the boiler-feed pumps, the economizer and then into the boilers.

Boiler-feed suction lines consist of a ring header with a 5,000-gal. surge tank for each unit. The make-up from the evaporator joins the main condensate, so that at times of varying load the excess overflows the surge tank to an evaporated water storage. This storage consists of two tanks connected in parallel, one of reinforced concrete and one of steel, the two having a combined capacity of 60,000 gal.

Water returning from storage is regulated automatically by a float mechanism in the surge tank, which operates a switch controlling the make-up pump. The

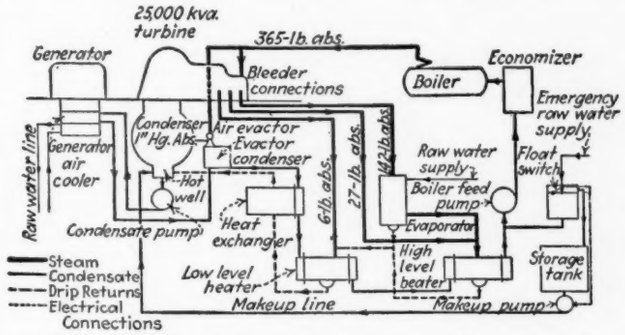


Fig. 8—Flow diagram for steam, condensate and drip returns

water from storage is introduced into the main condensers on the side of the shell with an arrangement to spill it in a thin sheet down the side of the condenser. The storage water is steam sealed by its own vapor, but any dissolved oxygen it may contain will be reduced in the condenser and hot well to such an extent that economizer corrosion is prevented.

Condenser and Service Water

Circulating water intake and discharge tunnels run side by side within the plant, and gates are arranged for recirculation to warm the water for fighting ice formations in front of the screens at the intake. The first section of the screen house is built to provide circulating water for 120,000 kw. and is equipped with four traveling screens, with provision for installing another set of similar screens in series with the first set if this is found necessary. Trash racks installed in front of the screen house may be cleaned by means of hooks and the use of high-pressure water streams. A suction well from the intake tunnel is provided for each circulating pump.

House service water may be obtained from the intake tunnel when river conditions are favorable or from a system of 8- and 12-in. wells drilled into the water-bearing gravel, for use when the river is high and carrying undesirable foreign matter in suspension. When river water is taken for house service use, it is clarified and the suspended matter removed by means of high-pressure filters.

Steam Piping

Meter-operated remote-controlled valves are placed at strategic points in the high-pressure piping system. To keep stresses down to a minimum value, long radius bends and loops are used freely. A 236-cu.ft. steam separator has been built to serve as an anchor in the steam header serving each main unit. The only other steam header anchors used in the high-pressure system are located where the boiler branch lines join the main headers.

Principal Equipment of Des Moines Power Station

GENERAL

Plant location	Des Moines River
Capacity installed, 1926, kva	60,300
Capacity ultimate, kva	166,200

Engineers, *Illinois Power & Light Corp.*, Engineering Dept., Chicago, Ill.
Contractor, *Arthur H. Neumann & Co.*, Des Moines, Iowa.
Consulting architects, *Proudfoot, Rawson & Sauers.*

BOILERS AND SUPERHEATERS

	Three, Babcock & Wilcox	Two Heine
Type	Cross drum	Cross drum
Steam-making surface per boiler sq.ft	15,018	15,018
Furnace volume, cu.ft	6,183	6,183
Steam-making surface, per cu.ft. furnace vol.	2.43 sq.ft.	2.43 sq.ft.
Boiler pressure, lb. gage	385	385
Superheat, deg. F	250	250
Total steam temp., deg.	695	695
Make of superheater	B. & W	Superheater Co.
Type	Interdeck	Interdeck
Superheater, surface per boiler, sq.ft	2,900	2,900
Ratio sup.surf.to steam-making surf., per cent	19	19
Soot blowers	Diamond Power Specialty Co.	
Feed water regulators—Copes	Northern Equipment Corp.	
Side wall screens	Fin tube type	
Manufacturer	Combustion Engineering Corp.	
Heating surf. per furnace	310 sq.ft.	
Ratio side wall screens to steam-making surface, per cent		
Suspended front and bridge-wall arches	Liptak Fire Brick Arch Co.	

ECONOMIZERS

Manufacturer	B. F. Sturtevant Co.	Power Specialty Co.
Surface per boiler sq.ft.	10,000	10,000
Ratio econ. surf. to steam-making surf.,	67 per cent	67 per cent
Soot blowers	Diamond Power Specialty Corp.	

AIR HEATERS

Manufacturer	Combustion Engineering Corp.
Type and number	Three plate
Heating surface, sq.ft	12,420

STOKERS

Manufacturer	Illinois Stoker Co.
Type	Forced-draft, chain grate
Ratio to steam-making surface	1 to 34

DRAFT EQUIPMENT

	F. D. Fans	I. D. Fans
Manufacturer	B. F. Sturtevant Co.	B. F. Sturtevant Co.
Number per boiler	1	1
Capacity,cu.ft.per min.	78,000	113,000
Water pressure, in	4.5	6
Drive	G. E. slip-ring drum control motor	G. E. syn.sp. motor
Horsepower	75	150

STACKS

Manufacturer	Rust Engineering Co.
Number and type	2, radial brick
Diam. at breeching, ft	17
Height above grates, ft	145
Breeching and flues	Connery Co.

COAL-HANDLING EQUIPMENT

Track scales	Fairbanks, Morse & Co.
Type	100 ton, reg. beam
Track hoppers—two	Robins Conveying Belt Co.
Capacity of each, tons	22.5
Apron conveyor to bunker	Robins Conveying Belt Co.
Capacity per hour, tons	150
Coal breaker—(Bradford)	Pennsylvania Crusher Co.
Capacity per hour, tons	150
Coal scraper (drag)	Sauerman Brothers
Capacity per hour, tons	150
Hopper scales	Richardson Scale Co.
Capacity of each per hour, tons	6
Spout swingers, Phillips double yoke	Henry Pratt Co.
Locomotive crane	Brown Hoisting Machinery Co.
Type	Clamshell bucket, 60 ft. radius
Capacity, cu.yd	1½
Gasoline locomotive	Milwaukee Locomotive Mfg.Co
Under water coal storage	Concrete lined
Capacity, submerged, tons	38,000
Capacity air storage, tons	12,000

ASH-HANDLING EQUIPMENT

Ash Hoppers	Allen-Sherman-Hoff Company
Gondola	Western Wheeled Scraper Co.

PRIME MOVERS

Manufacturer	General Electric Co.	
Number installed	One 25,000 and one 35,300 kva.	
	25,000-Kva. Unit	35,300-Kva. Unit
Space occupied, ft	51x19x13	51x20x13
Number of stages	14	17
Bleeder points	Stages 3, 8 and 11	Stages 10, 12 and 14
Steam press. at throttle	350	350
Superheat, deg. F	250	250
Type of generator	3 ph., 60 cyc., 13,800 v.	3 ph., 60 cyc., 13,800 v.
Ventilation of generator, c.f.m	60,000	85,000
Exciter	220 kw., 250 v., dir.con.	250 kw., 250 v., dir. con.

MAIN UNIT AUXILIARIES

Condensers	25,000-Kva. Unit	35,300-Kva. Unit
Manufacturer	Allis-Chalmers Mfg.Co.	Westinghouse
Type	Cyl., 2 pass.	2 pass., radial flow
Ratio surface to kw.	1.5	1.6
Generator Air Coolers		
Manufacturer	General Electric Co.	General Electric Co.
Type	Surface, 4 main sect.	Surface, 4 main sect.
Air cooling surface, sq.ft.		
Main sections	9,480	11,850
Auxiliary sections	4,740	5,925
Heaters		
Manufacturer	Cochrane Corp. 11th Stage Heater	Cochrane Corp. 14th Stage Heater
Type	4 pass., floating head,	4 pass., floating head,
Heating surface, sq.ft	1,400	2,000
	8th Stage Heater	12th Stage Heater
Type	4 pass., floating head,	4 pass., floating head,
Heating surface, sq.ft.	1,200	1,800
Heat exchanger heating surface, sq.ft.	200	
Evaporator		
Manufacturer	Bethlehem Shipbuilding Corp.	
Type	Weir, ver., subm.—tube, double-effect	
Number	1	1
Capacity, lb. per hr.	10,000	12,000
Press. at full load, lb.	137	48
Steam from	3rd stage	10th stage
Hot Well Pumps		
Manufacturers	Allis-Chalmers Mfg.Co.	Westinghouse
Number	2	2
Capacity, g.p.m	650	950
Circulating Pumps		
Manufacturers	Allis-Chalmers	Westinghouse
Number	2	2
Capacity, 30 ft. head, g.p.m	17,000	25,000
Drive	150-hp. 2,300-v. ind. motor.	250-hp. 2,300-v. ind. motor
Air Pumps		
Manufacturers	Croll-Reynolds	Westinghouse
Number	2	2
Type	Twin, 2-stage evactors	Twin, 2-stage evactors

PUMPS

Boiler Feed Pumps		
Manufacturer	Allis-Chalmers Mfg. Co.	
	Motor Driven	Steam Driven
Number	2	1
Stages	7	5
Capacity at 1,050 ft. hd., g.p.m	650	650
Drive	Allis-Chalmers, 300-hp., ind. motor	G.E., 275-hp. Curtis turbine
Fire Pumps (one)		
Manufacturer	Allis-Chalmers Mfg. Co	
Type	Centrifugal	Centrifugal
Capacity, 462 ft.hd., g.p.m	1,000	1,000
Drive	200-hp.ind.motor	200-hp. turbine
House Service Pump (one)		
Type	Centrifugal	
Capacity, g.p.m	1,000	
Drive	100-hp., 2,300-v. ind. motor	
Sump Pumps (two)		
Manufacturer	American Well Works	
Type	Single-stage, open impeller, ver.	
Capacity, 61-ft. hd., g.p.m	250	
Drive	G.E., 10-hp., 440-v. ind. motor	
Make-up Pumps		
Manufacturer	Fairbanks, Morse & Co.	
	Motor Driven	Turbine Driven
Capacity, 75-ft. hd.,	75 g.p.m.	75 g.p.m

MISCELLANEOUS MECHANICAL EQUIPMENT

Air compressor, (one)	Worthington
Capacity, cu.ft. per min	355
Pressure, lb. gage	100
Drive	50-hp., ind. motor
Elevators	Hollister-Whitney Co.
One freight, capacity, lb	10,000
One passenger, capacity, lb	6,000
Traveling crane, main hoist 85 ton, aux. hoist 10 ton	Whiting Corp.
Water filter, 2 tank, sand, 100 g.p.m. at 100 lb. pressure	Graver Corp.
Oil filter, 300 gal. per hr	Wm. W. Nugent Co.
Revolving screens	Chain Belt Co.

GAGES, METERS AND INSTRUMENTS

Indicating thermometers	Precision Therm. & Inst. Co.
Recording Thermometers	Foxboro, Inc.
Indicating pressure gages	American Schaeffer & Budenberg Corp.
Recording pressure gages	Foxboro, Inc.
Boiler control instruments	Bailey Meter Co.
Warren clock system	General Electric Co.
Flow meters	General Electric Co.
Barometer	Precision Therm. and Inst. Co.
Mercury column gage	Precision Therm. and Inst Co.

VALVES AND PIPING

Turbine headers, motor-operated	Crane Co.
Circulating water, motor-operated, Payne Dean control	Kennedy Valve Mfg. Co.
Safety, Consolidated	Manning, Maxwell & Moore
Blowoff	Yarnall-Waring Co.
Non return	Schutte-Koerting Co.
Atmospheric relief	G. M. Davis Regulator Co.
Sluice gates	Chapman Valve Co.
Boiler stop and check	Edward Valve & Mfg. Co.
Bleeder gate valves	Walworth Mfg. Co.
Bleeder non-return	G. M. Davis Regulator Co.
High-pressure steam piping and fittings	Crane Co.
Circulating water piping	LocomotiveFinishedMaterialCo.
Pipe covering	Johns-Manville, Inc.

Boiler meters are provided for each boiler, with additional flow meters in the feed-water line to the economizer. Recording temperature instruments are used to record the temperature of gases leaving the boiler, economizer and air preheater, as well as the temperature of the water in and out of the economizer and the air in and out of the air heater. The temperature of the steam leaving the superheater is recorded. An indicating draft instrument is installed on each boiler. Flow meters indicate the rate of steam flow to the main turbine and to each piece of heat balance equipment. Thermometers indicate temperatures at various locations and gages indicate and record steam and water pressures. By means of these instruments the operators in the power station are able to check the performance of the entire plant from a thermal point of view.

In laying out the electrical work special care was taken to design a system that would be flexible and simple to operate. Duplicate main and auxiliary buses are provided and the buses for the auxiliary motors are sectionalized, so that the auxiliaries for each main unit are served from a separate section of the auxiliary bus. Likewise the 2,300-volt circuits may be carried on either section of the station auxiliary bus.

Provision has been made for sectionalizing the main bus either through reactors or without reactors in the circuit. The 13,800-volt outgoing feeders may be energized from either generator, owing to the sectionalizing switches, but the normal practice is to energize all feeders from the generators that share the load by operating in parallel. The neutral of either generator may be connected to ground through a circuit breaker and a 1,600-amp., 5-ohm resistor.

Auxiliary Service at 2,300 and 440 Volts

Station power is obtained from 2,300-volt auxiliary sectionalized buses, with a transformer feeding each section. The main circuits off these buses, are controlled through truck type switches and all 2,300-volt motors of the squirrel-cage type are started on full voltage. The slip-ring motors driving the forced-draft fans and the motors on the induced-draft fans are provided with dual remote controls, one located at the motor on the fan floor of the boiler room and the other on the boiler control board. A 440-volt station auxiliary bus, likewise divided into two sections, supplies power to motors of 40 hp. or less, all of which are started at full voltage. Three-phase 230/115-volt service is made available for lighting, and there is provision for emergency lighting through an automatic throw-over switch to the storage battery.

The design, engineering and superintendence of this plant has been carried out entirely by the engineering department of the Illinois Power & Light Corporation under the direction of T. J. Lucas, chief engineer. The Illinois Power & Light Corporation is one of the important subsidiaries of the North American Light & Power Co., of Chicago, which is controlled by the Studebaker interests.

The Joys of Operating a Stand-by Plant—V*

By "THE CHIEF"

IN A former issue I spoke about the Devil finding work for idle hands. The same gentleman also finds or makes trouble for idle power stations in the shape of rust, erosion, corrosion, dry and wet rot, and last but by no means least, *leaks*—steam leaks, water leaks and every kind of a leak you ever heard of, but the steam leaks take the blue ribbon.

When we were the King Pin, we had about the same number of leaks as any well-regulated plant of this size would have, and had no trouble in keeping them to a minimum, but since we've become the home for aged and indigent has-beens it's a different story. *Leaks*—let me tell you that they are worse than the coal pile! It's a steady job for someone every day, and the leaks are about four laps in the lead and going strong. If we run today, a new crop is on hand to greet us in the morning. They don't say, "Good morning, Judge," but just blow.

We use the same brand of packing as always and use just as much care in packing valves or gaskets as ever, but the difference in temperature when running and standing by, combined with excessive condensation in the lines, sure does raise hob with the steam lines in general.

Rust—we never knew what that stuff was before we joined the Salvation Army, but we know now! If it weren't for elbow grease, red lead (or some other kind of disguiser) and keeping eternally at it, we would be nothing but a memory by this time.

Someone said that nothing is lost—just takes some other form. They are crazy—*not lost?* If you can tell me what use a perfectly good coal conveyor is that has changed its sylphlike form to a pile of oxide of iron I'm willing to learn! It may not be lost, but it might just as well be for all the use it will be in bringing in coal. But don't forget to keep the old red lead pot where it will always be ready to use—and use it.

In a base-load power station an engineer is an engineer, an oiler is an oiler, a repairman does overhauling in the turbine room, a boiler man works on boilers, a stoker repairman works on stokers. Whatever instrument you play in the band is your particular line and you don't get much opportunity to learn any of the others. You are a specialist in that particular line and can do that job (if you have learned it the way you should) better than someone else, and the others can do theirs better than you can.

But in the old stand-by it's a different story; here each of the boys has his specialty, but he doesn't work at it except on rare occasions. An engineer or oiler or stokerman (or whatever he may be in civil life) has to be not only a jack of all trades but master of them all. One time he's a painter, the next a pipe fitter, a plumber or machinist. One day he is working on pumps or boilers and the next cleaning out the bilge or cooking sauerkraut and frankfurters—for the boys still like to eat, even though they don't do anything but work all day. Every cloud has a silver lining; while we don't carry load very much, the boys are getting a good all-around broad experience that will make them valuable men when they grow up and graduate into some other job.

*This concludes a series of which the preceding installments appeared in the issues of March 16, March 30, April 6 and April 13.

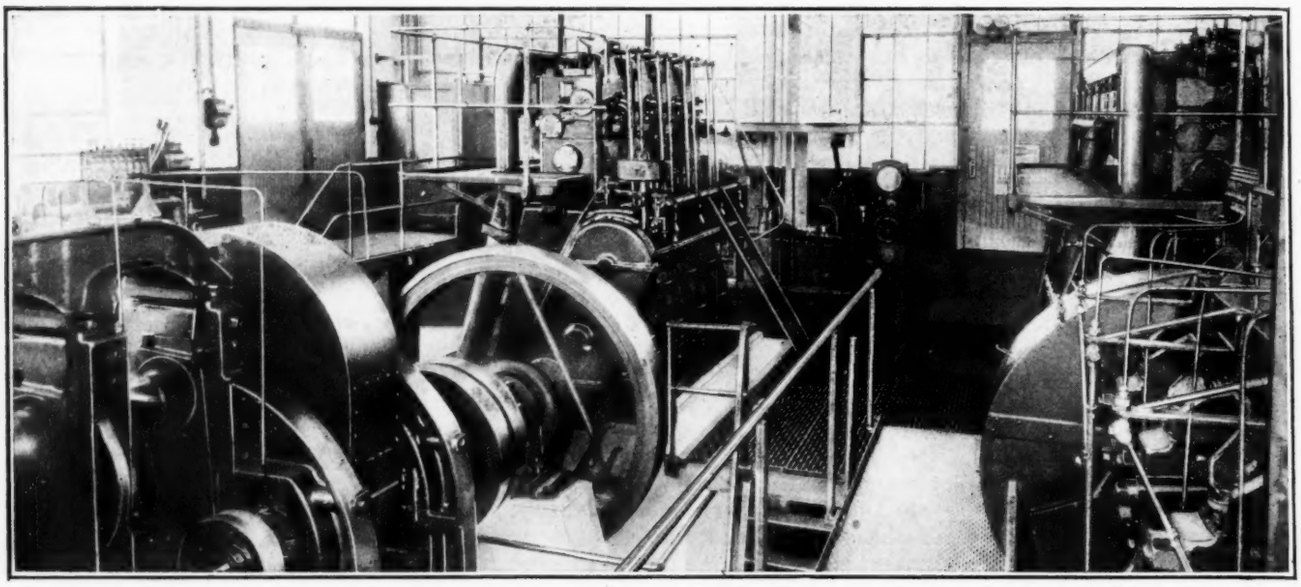


Fig. 1—Interior of Selkirk pumping station

Novel Speed Control for Diesel Engines

BY EDGAR J. KATES

The New York Central Railroad has placed a water-pressure regulated speed control on Diesel engines driving pumps in one of its water stations, which solved the difficult problem of wide-speed regulation of such oil-engine-driven units.

ABOUT a year ago the New York Central Railroad put into service its $25,000,000 improvement known as the Castleton cutoff. This consists of a bridge across the Hudson River about fifteen miles south of Albany and a five-mile freight classification yard on the west side of the Hudson near Selkirk, N. Y.

There is naturally a large demand for water in such a freight yard, and this has been taken care of by providing on the bank of the Hudson River a Diesel pumping plant, which delivers the water through a four-mile pipe line. There are two pumping units, consisting of triplex plunger pumps having a capacity of 2,500,000 gal. per day, direct connected through gearing to a 260-hp. solid injection Diesel engine. The pipe line, which is 16-in. diameter, supplies a wide variety of services, the principal one, however, being the water supply for the locomotives, and on account of the irregular intervals at which the freight trains arrive, the demand for water is exceedingly uneven. For instance, in the winter time snow blockades may hold up a number of trains, which subsequently arrive at the freight yards practically at the same time.

The Diesel engines were originally equipped with hand-controlled variable-speed governors arranged so that by turning a handwheel the governor spring tension was altered and the engine speed could be set for anything from full speed down to half speed. It was found, however, that the variations in water demand were so frequent that it was physically impossible for the operator to regulate the engine speed to follow the requirements. Accordingly it became the practice to set the engine for about three-quarter speed and to depend upon the water relief valve on the pump discharge to bypass the excess water whenever the demand fell off and the pressure rose. A typical water demand curve is shown in Fig. 2 and illustrates the bad features of this practice. With the engine speed set to deliver 2,000,000 gal. per day, each time the demand curve dropped below this rate the water relief valve would open and would waste water back to the river. During

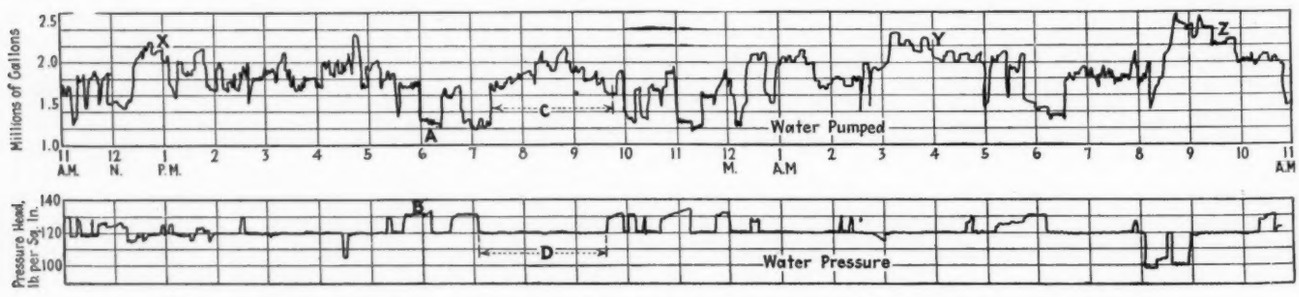


Fig. 2—Chart showing water pumped and water pressure after control was installed

the 24 hours shown on the chart, the relief valve was open about 16.4 hours and the amount of water wasted, with the pump delivering at the rate of 2,000,000 gal. per day, was more than 1,300,000 gal. Furthermore, in spite of the fairly high engine speed, there were times, such as *X*, *Y* and *Z* on the chart, when the water delivered did not satisfy the demand.

The great waste of fuel involved in this practice caused the engineering department of the railroad to seek a remedy, and by co-operation with the De la Vergne Machine Co. and the Smoot Engineering Corporation an automatic governing system was developed to maintain a constant pressure on the pipe line independently of the water demand. To work this out successfully, it was also necessary to prevent the engine ever running faster than its rated full speed or slower than half speed. In other words, the automatic engine control by water pressure had to be kept within these speed limits. Furthermore, an emergency overspeed check was included.

The control unit was specially designed to replace within nearly the same space the conventional flyball governor previously used, but its constituent elements had already been well developed in connection with boiler control systems. In Fig. 1 the engines still had the original flyball governors. Fig. 3 illustrates the control unit that was developed and Fig. 4 gives a diagrammatic picture of the control system.

The pressure control element *A* is a spring-loaded diaphragm, arranged for variable settings to give any desired pump discharge pressure. The movement of the diaphragm, corresponding to line pressure changes, is transmitted through the lever L_1 and L_2 to the regulator proper, or power element, shown at *B*.

An increase in pressure causes L_1 to leave contact with L_2, which relieves the opposition to the action of the governor *C*. As a result the governor balls move outward and pulling down the left end of the lever L_2 opens the small bypass valve at the right of *B*. The oil under the lower piston of *B* escapes through the valve

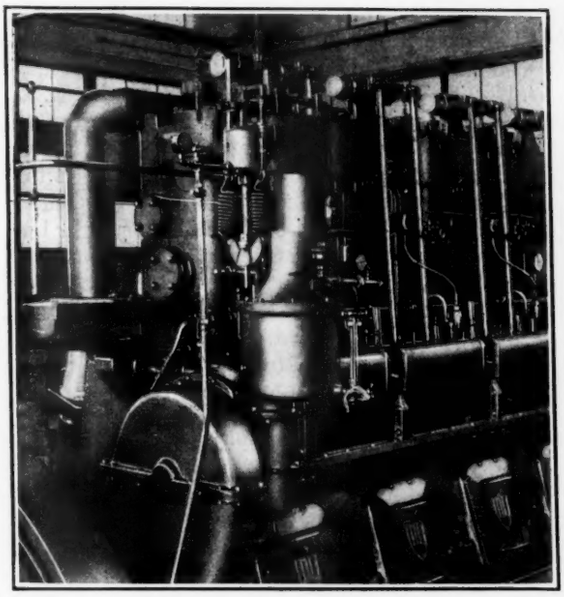


Fig. 5—Engine with control unit in place

opening and the downward movement of the piston shifts the engine regulating shafts to the minimum position and the engine speed is lowered.

The movement of this power device directly actuates the engine governor regulating shaft, giving complete command of the engine speed to the control system at all times. The stabilizing device, giving the necessary dead-beat characteristic required by all of the elements, is built into this part of the regulator.

On the other hand, when conditions are reversed and the water demand becomes heavier, the level L_1 rises and coming in contact with L_2, causes the bypass to close. This in turn permits oil pressure to build up under the lower piston of *B*, causing it to rise and shift the fuel regulating valve to the maximum position.

The safety or emergency device shown at *D* is set to

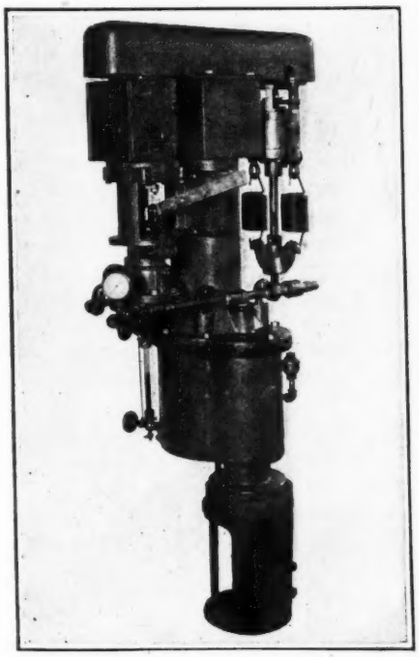


Fig. 3—Automatic control unit

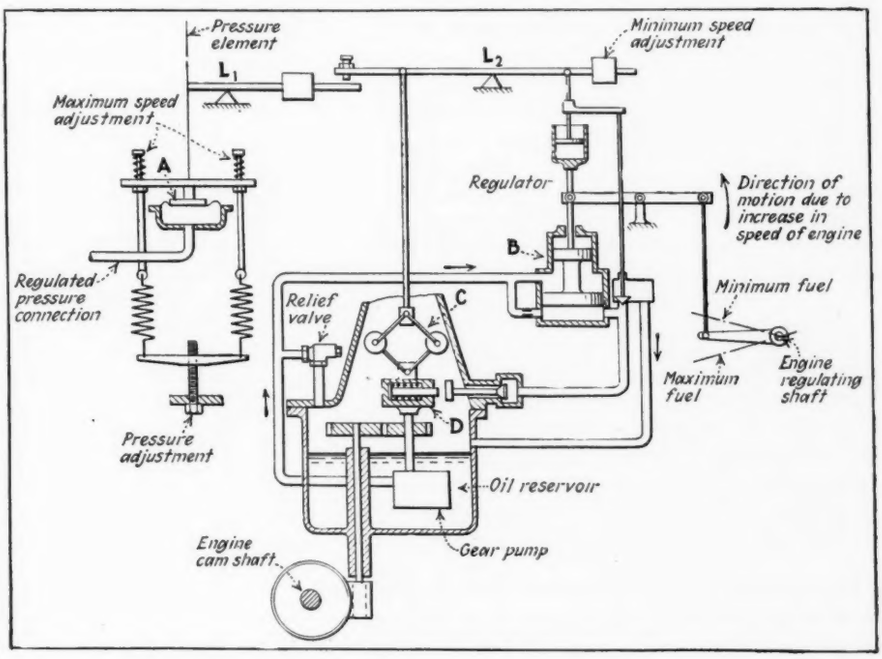


Fig. 4—Diagram of control system that was developed

trip at a few per cent above full speed, thus operating only when a very heavy or sudden load drop takes place, such as when a pipe main bursts, demanding immediate and unfailing action. This control bypasses, so to speak, the other control elements and acts directly on the regulator piston pressure, thus completely controlling the speed of the engine in the event of failure on the part of the regular maximum speed element or until the extreme pressure condition is brought back to normal, at which time the emergency trip automatically disengages and allows the pressure element to take over the engine control on a straight pressure-control basis.

The rotary element is directly connected to the engine camshaft through a suitable vertical shaft and gearing, built into the regulator-supporting frame in such a way that with the same movement a gear oil pump is driven by the vertical shaft. This oil pump supplies the regulator with its motive fluid at 30 lb. pressure, and as it is a very simple and rugged device of several times the required capacity, there is assured at all times a positive and smooth operation of the regulator as long as the engine is in operation.

The lower, or pressure curve in Fig. 2, taken in connection with the upper curve, shows the pressure regulation accomplished by this control system. The regulator is set for 120 lb. pressure and it will be noted that this pressure is maintained up to the point where the speed control is limited by the full-speed or half-speed limits. For example: At Point *A* in Fig. 2 the demand had dropped off so much that even running at half speed the pump still furnished excess water and the pressure accordingly rose to about 130 lb. at *B* on the lower curve where the relief valve opened. However, this lasted but a short while, and when the demand increased a little, the pressure was promptly brought back to normal and the relief valve closed. It will be seen that the relief valve was open only 2.9 hours out of the 24. Keeping in mind also that when the relief valve opens the engine is running at only half speed, corresponding to 1,250,000 gal. per day, the wasted water is 150,000 gal., which is a reduction of 89 per cent of the waste with hand control. Even this remaining waste is to be eliminated by the use of a reserve water tank floating on the line.

The remarkably close regulation of the pressure whenever the demand is between the two limits of speed is shown by a comparison of the portion of the upper curve marked *C*, Fig. 2, with *D* on the lower curve. During two hours the water demand varied from 1,600,000 to 2,100,000 gal. per day, whereas the pressure remained constant at 120 lb. within a limit of 1 lb. either way.

AN EXTENSIVE STUDY of what happens when copper is soft-soldered was reported by T. B. Crow, at the March meeting of the Institute of Metals in London. Although the paper is rather technical, the practical man will be interested in one of the author's conclusions—namely, that the tensile strength of the joint increases as the layer of solder is made thinner, up to the point where there are breaks in this layer.

THE EXPERIENCE OF INDUSTRY shows that about 25 per cent of accidents are due to lack of mechanical safeguards and breakdown of equipment, and about 75 per cent are caused by failure of the human element.—*N.E.L.A. Bulletin.*

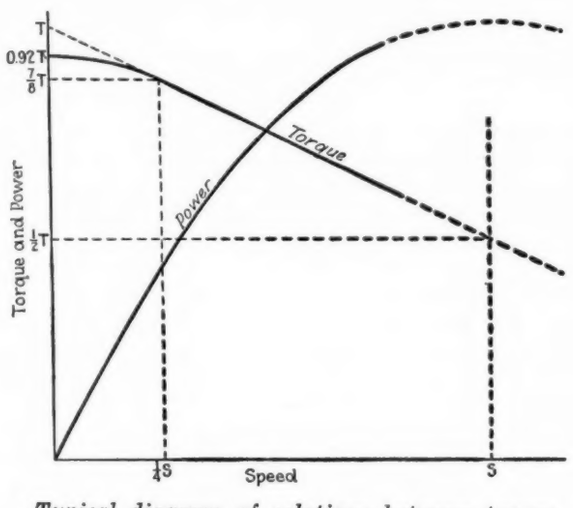
Steam Turbines for Variable Speed Operation*

Brake Tests on Three Impulse Turbines Illustrate a Simple Graphic Method for Determining Output at All Speeds

BY DR. RUDOLF LORENZ
Essen, Germany

TESTS made on three impulse turbines for locomotive service afforded opportunity for measuring the turning moments of these machines with constant total steam consumption at speeds ranging from zero to the maximum attainable.

The turning moment, in pound-feet, equals the power, reduced to foot-pounds per second, divided by 2π times



Typical diagram of relations between torque, power and speed for constant total steam flow

the speed in revolutions per second. If this torque be plotted against speed, for constant total steam consumption, the resulting curve will be a straight line, except at low speeds, where the torque falls off to about 0.92 of the straight-line value at zero speed. This is the starting torque of the turbine.

The product of torque times speed times 2π gives the power in foot-pounds per second, and this curve will be a true parabola, except at the lower speeds. The maximum power corresponds to a torque equal to half of the theoretical starting torque.

These relations make it possible to construct approximate performance curves from scanty experimental data. Two tests with the same total steam consumption at different speeds will give two points establishing the torque-speed line. This is extended back to zero speed, and the actual starting torque is taken as 0.92 times the theoretical. A parabolic curve is drawn from this point to be tangent with the straight line at a point corresponding to about seven-eighths of the theoretical starting torque, or about one-fourth of the speed corresponding to maximum load development.

From the torque-speed curve the power-speed curve can be easily computed, and from this any desired thermal economy results may be worked out.

**Zeitschrift des Vereines deutscher Ingenieure*, March 6, 1926, p. 314.

Effects of Low Power Factor on Alternator's Voltage

Explains How When the Power Factor Is Lagging the Armature Current Tends to Weaken the Main Poles and When Leading, the Armature Current Strengthens the Main Poles of the Machine

By C. O. MILLS

LOW POWER FACTOR has many bad effects on the operation of a power system, such as decreased kilowatt capacity of lines, transformers and generators, increased losses in the system, increased cost of equipment to serve a given kilowatt load, increased complications in operation under certain conditions and impaired voltage regulation. It is with the latter that this article deals. If the power factor of the load that an alternator is supplying is lagging, it will require a greater field current to maintain the voltage constant than if the power factor were unity. On the other hand, if the power factor is leading, a smaller field current will be required to maintain the voltage constant than at unity power factor. In other words, a lagging power factor has the effect of demagnetizing the field poles, whereas a leading power factor has a magnetizing effect. Why this is so will be explained in the following.

In Fig. 1 is shown a diagram of a ring armature between two polepieces. If the field coils only have current flowing in them, the lines of force will be equally distributed across the field poles as indicated. Leaving the field coils dead and passing a current through the armature winding would produce an effect as in Fig. 2. The current flowing in the two halves of the armature winding produces an *N* pole on the left-hand and an *S* pole on the right-hand side of the armature. This will result in a magnetic field being set up that passes around across the polepieces as shown.

Comparing Fig. 1 with Fig. 2, it will be found that at the left-hand side of the *S* main pole the two fields have the same direction; therefore one is assisting the other, and this will tend to make the resultant field at this side of the pole more dense. On the right-hand side of the main *S* pole the armature field opposes the field from the main poles. That is, the field from the armature is down, whereas that of the main pole is upward. The armature field opposing the field of the main pole will weaken it. The opposite effect is produced on the *N* pole. On the left-hand main-pole tip the armature field opposes the field of the main pole—that is, the armature field is downward where the main-pole field is up. On the right-hand main-pole tip the two fields are in the same direction. This would result in the left-hand side of the field being weakened and the right-hand strengthened.

The net result of one field on the other (Figs. 1 and 2), is somewhat as represented in Fig. 3. The *N* pole of the armature repelling the *N* main pole will tend to push its field to the right and attract the *S* main pole's field, whereas the *S* armature pole will attract the field of the *N* main pole and repel the field of the *S* main pole. This will result in distorting the field from the main poles somewhat like that shown in the figure.

What has been shown in Figs. 1 and 3 represents what takes place in any generator. When there is no load on the machine, no current is flowing in the armature and this part of the machine has no magnetic field. The only parts magnetized are the polepieces, and the lines of force can take a natural course as shown in Fig. 1. As the load increases on the armature the current through its windings is increased and its magnetic poles increase in strength and cross-magnetize the main poles, weakening them on one side and strengthening them on the other, as shown in Fig. 3. The greater the load the greater will be the distorting of the field.

Theoretically this distorting of the field should not weaken the main poles, since the armature poles are located at an equal distance from each polepiece. Therefore the building up effect at one pole tip should equal the weakening of the other. There is a weakening of the field poles due to the pole tips that are strengthened becoming saturated, but with the armature poles located equally distant from the main poles the effect will be a minimum.

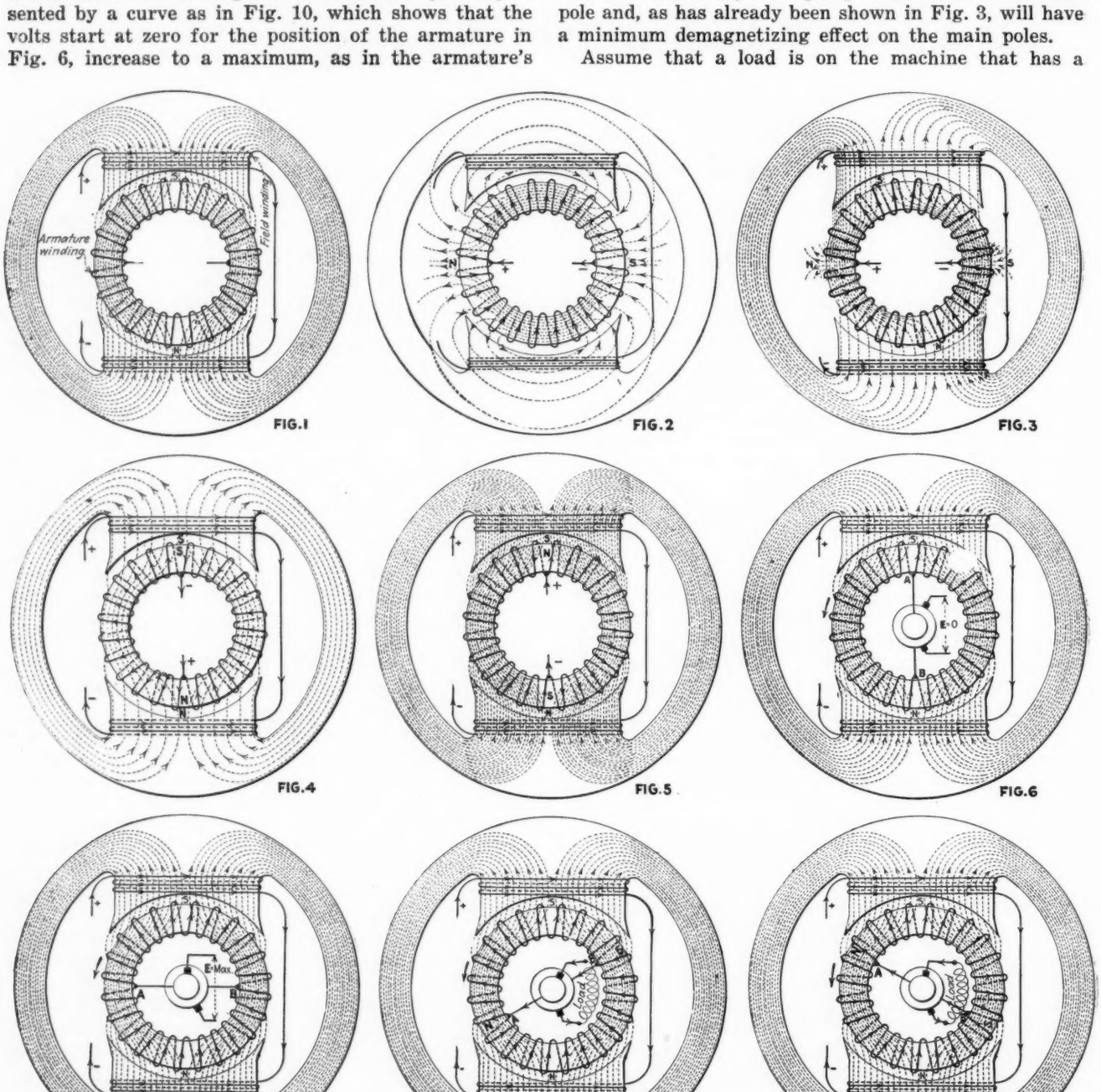
If the armature was revolved through 90 deg., so that the *N* pole of the armature is directly under the *N* main pole, as in Fig. 4, the armature poles would directly oppose the main-pole field with a maximum weakening effect. Turning the armature so that its *N* pole comes under an *S* main pole, Fig. 5, produces a condition where the poles of the armature assist the main pole, with the result that they are strengthened as indicated. The effects shown in Figs. 3, 4 and 5 are similar to those that take place in an alternating-current generator and vary with the power factor of the load.

Fig. 6 represents a simple single-phase alternator. Assume that the armature is rotating in the direction indicated by the curved arrow. This would result in a voltage being generated in the armature winding having a direction shown by the arrowheads. With the armature in the position shown, the voltage across the brushes is zero. The voltage generated in the conductor under any one pole is in the same direction, but tracing the circuit from *A* through the right-hand half of the winding to *B* shows that the voltage in the upper quarter of the winding opposes that in the lower quarter. As the voltage in the two sections is equal, the resultant voltage is zero. The same will be found true when following the left-hand half of the winding through from *A* to *B*.

In Fig. 7 the armature is shown revolved one-quarter revolution from the position in Fig. 6. Tracing through the two circuits in the armature from *A* to *B*, it will be found that the voltage in the conductors in each circuit is in the same direction. This gives a condition of

maximum voltage at the brushes. If the armature is turned through another quarter of a revolution it will again be in a position where the voltage at the brushes will be zero. This voltage at the brushes may be represented by a curve as in Fig. 10, which shows that the volts start at zero for the position of the armature in Fig. 6, increase to a maximum, as in the armature's same time as maximum volts, it will occur when the armature is in the position Fig. 7. This has the maximum value of N and S poles of the armature occurring at a time when they are equally distant from each main pole and, as has already been shown in Fig. 3, will have a minimum demagnetizing effect on the main poles.

Assume that a load is on the machine that has a



Figs. 1 to 9—Effects of the armature current upon the field poles

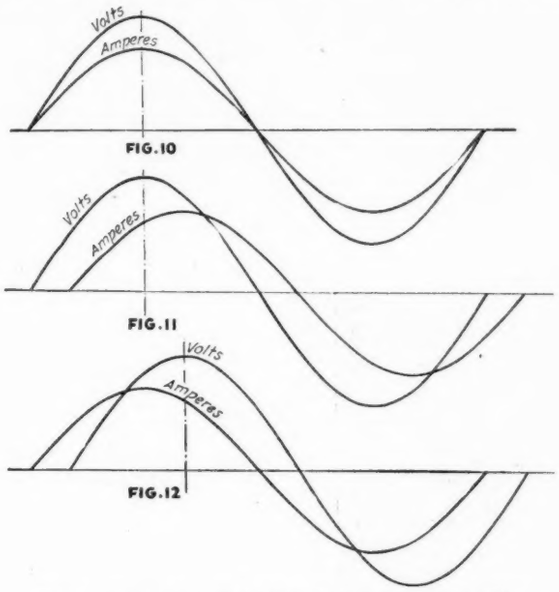
position Fig. 7, then decrease to zero, as would be found to be the case for another quarter revolution. For the next half revolution of the armature the voltage at the brushes would be reversed as is represented by the voltage curve below the line Fig. 10.

When the power factor of a circuit is unity, the current is zero when the voltage of the generator is zero and at a maximum when the voltage of the generator is at a maximum, as in Fig. 10. Since the maximum current in the circuit at unity power factor occurs at the lagging power factor, as represented by the curves, Fig. 11. In this case the maximum voltage occurs at the same instant as in Fig. 10, but the current does not reach maximum until some period later. In other words, the maximum voltage occurs when the armature is in the position Fig. 7, but the current does not reach maximum until the armature has had time to turn to some such position as that indicated in Fig. 8, which shows the machine connected to a load.

This load, say, consists of induction motors, and these

always have a lagging power factor. The effect of the lagging current has been to cause the poles of the armature to reach their maximum strength when they are closer to the main poles than in Fig. 7, which is the condition for unity power factor. The armature pole that has been brought closer to a given main pole is of the same polarity as the latter. That is, the *S* armature pole has been brought closer to the *S* main pole and the *N* armature pole is nearer to the *N* main pole.

Bringing the armature poles, when at their maximum value, closer to a like main pole, will increase the demagnetizing effects of the armature on the main poles. Therefore with a given field excitation and load on the machine the voltage will be lower with the current lagging than when the current is in step with the voltage. This demagnetizing effect will increase as the load increases on the machine, so that if the voltage is to be maintained constant the field current must be increased as the load increases. This is true in any case, but the farther the current lags behind the voltage the greater the demagnetizing effect of the armature current upon the main poles.



Figs. 10 to 12—Relation between alternating current and voltage

Fig. 10—Current in step with the volts. Fig. 11—Current lagging the volts. Fig. 12—Current leading the volts.

If the current were to lag 90 deg. behind the voltage —that is, the current reaches a maximum when the voltage is zero and the current is zero value when the voltage is maximum—then the armature poles would reach a maximum value when they were in the center of the main poles as in Fig. 4. This would give a maximum demagnetizing effect, since the two poles are in direct opposition. A 90 deg. lag of the current behind the voltage is only a theoretical condition and is only approached in practice. Induction motors operating under no load have a very low power factor and the current in this case will lag about 80 deg. behind the voltage on an average.

On loads having a leading power factor the current reaches its maximum value before the voltage, as shown in Fig. 12. This being the case, the armature's magnetic field will reach a maximum value at an instant before the armature is in the position of maximum voltage, or in some such position as shown in Fig. 9. The effect of this is to bring the armature poles, when they are at a maximum strength, under main poles having an opposite polarity to those of the armature. This produces a condition where the armature poles assist the main poles and increases their strength. Increasing the strength of the main poles will increase the voltage. Taking the extreme case, where the current leads the voltage by 90 deg., the armature poles would reach their maximum strength at the center of the main poles and the relation between the poles would be that shown in Fig. 5. The armature poles in this position will have a maximum effect in magnetizing the main poles.

If it were possible to control the power factor of the load, alternators could be operated without any excitation other than that supplied by the magnetizing effects of the leading current. In the foregoing a ring armature has been used to illustrate the effects, but these would be the same with any other type of machine.

Care in the Location of Electrical Equipment

By Clair L. Keene*

THE LOCATION of rotating electrical machines affects their useful life and operating characteristics to no small degree. It has an important bearing upon the nature and extent of maintenance and repairs. It quite frequently determines whether a machine is a good risk or an undesirable one for an insurance company. The following conditions should be met to insure satisfactory operation:

The machine should be placed in a well-ventilated room and furnished with a constant supply of cool air. The ventilating ducts of the machine should be examined occasionally to see that they are not clogged with dirt. Insufficient ventilation with consequent heating of machine parts causes deterioration of the insulation and reduces the capacity of the machine. If washed air is used, care should be taken that the air does not absorb an appreciable amount of moisture.

The moisture in insulation has a definite relation to its ohmic resistance. Protect the machine from moisture and escaping steam. Oftentimes moisture condenses on the ceiling and overhead pipes; this should be prevented from falling on the equipment. The machine should not be placed in a room where a hazardous process is being carried on or where combustible material is flying around. It should be shielded from dust, dirt and lint, especially during construction work. It should not be operated in an atmosphere where acid fumes or corrosive gases are prevalent, as this condition is likely to cause faulty commutation and the disintegration of the windings. Ample space around the machine should be provided so that the machinery can be under constant supervision and the time expended for maintenance reduced to a minimum.

Maintenance Costs of Diesel Engines—Max Rotter, consulting engineer, Busch-Sulzer Bros. Co., has stated that records carefully kept over an extended period indicated that maintenance might be figured conservatively to be $1 per 2,500 b.hp.-hr. for small engines, down to $1 per 5,000 b.hp.-hr. for large units, this being substantially the same as for equivalent steam plants, including the boilers.

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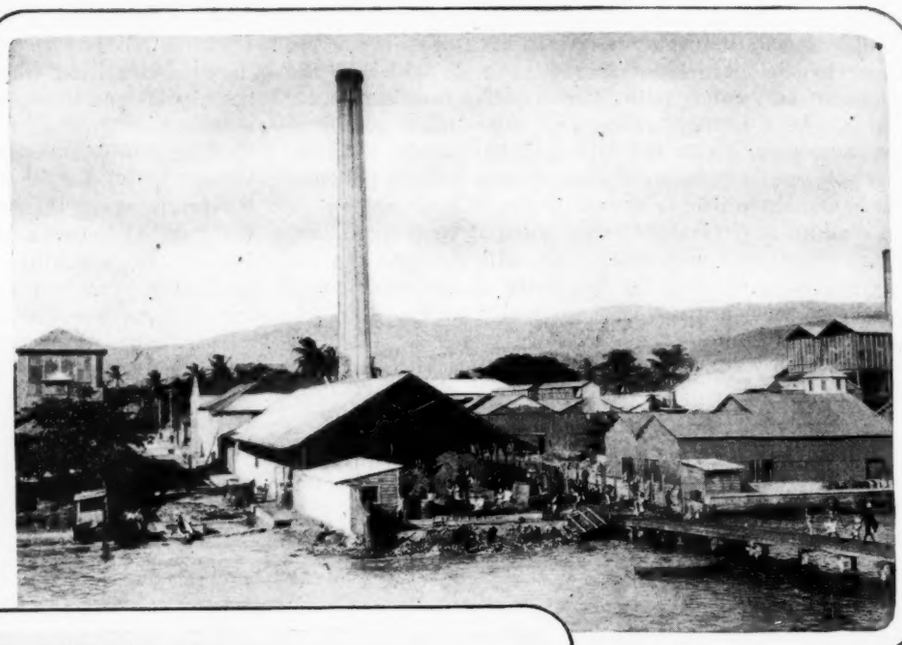
*Field Engineer, Columbia Casualty Co., New York City.

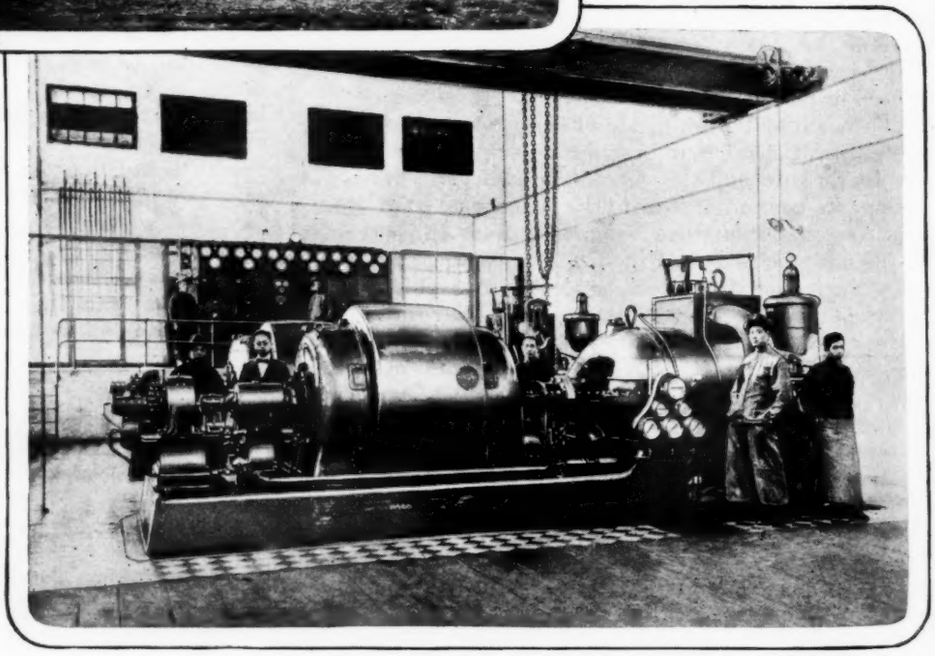


Cheap labor explains the primitive method of handling fuel employed in Jamaica. Natives carry the coal in baskets from ship to plant. They work in relays and are paid "C.O.D." as each basket comes in.

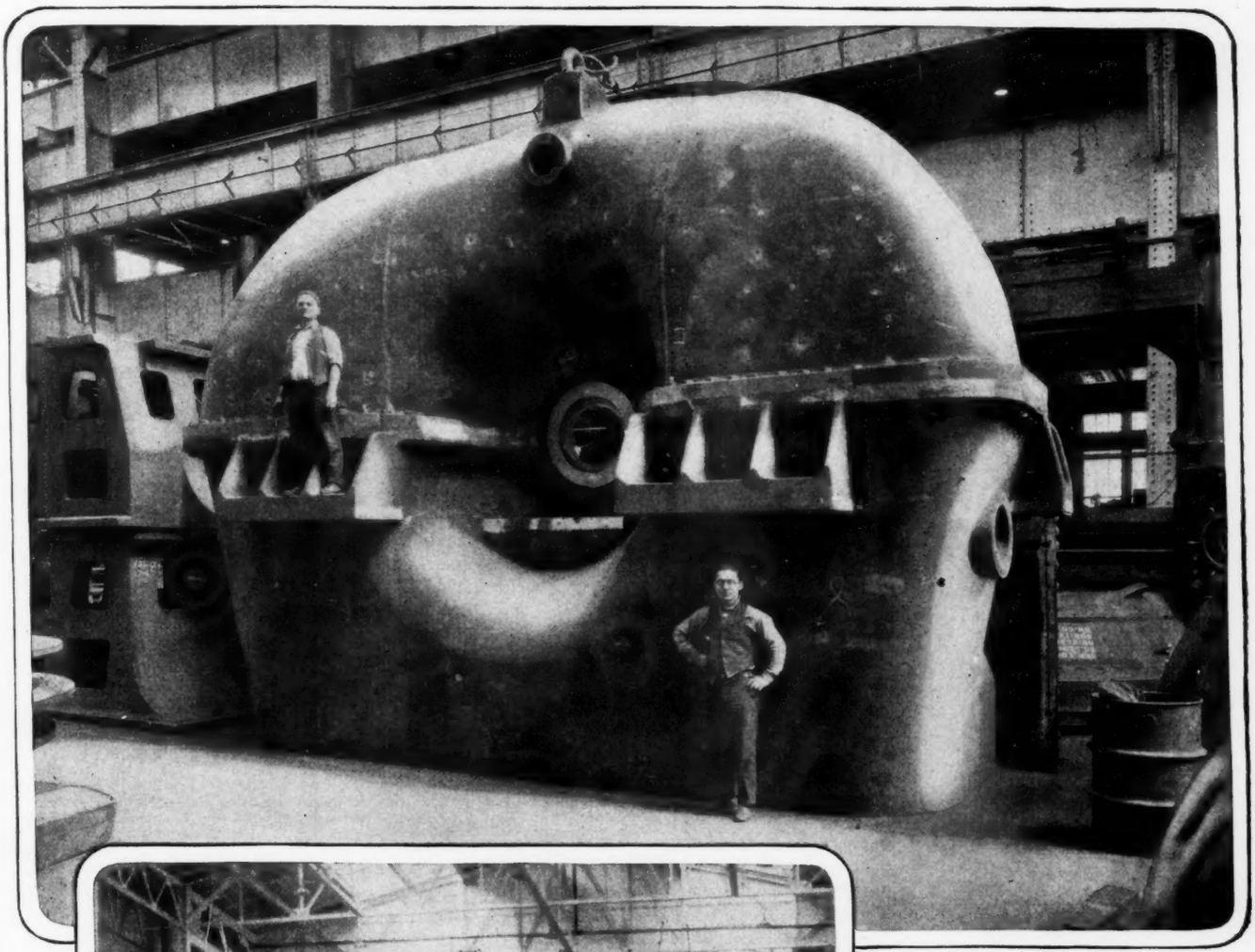
Photo reproduced by Courtesy of Stone & Webster Journal

"Walchensee Werk," recently completed at Kochel, Bavaria, and said to be Europe's largest hydro-plant, supplies 168,000 hp. for electrified railways.

Photograph by Ewing Galloway, N. Y.



Nothing could be more significant of the change that is coming over "unchanging" China than this picture of two 750-kw. Westinghouse turbines surrounded by citizens of the republic. The units are installed in the Yu Ta Cotton Mill near Tientsin.



Above—Fifty-seven tons of iron! Exhaust-end casing for 50,000-kw. steam turbine under construction in the Schenectady plant of the General Electric Company.

Left—Spark leaps twenty-one feet in 2,100,000-volt test at the Pittsfield G.E. laboratories.

This six-transformer testing set is for Leland Stanford University, California. The spark may be seen between suspended rods in line with the crane. The dark supporting cylinders are of a newly developed insulating material of high mechanical strength.

Operating Experience In a Flour Mill Power Plant

Experience with the Burning of Lignite, Raw and Carbonized, Alone and Mixed with Bituminous Coal Screenings, on Underfeed Stokers

By OSCAR S. BERG
Chief Engineer, North Dakota State Mill and Elevator

THE POWER PLANT of the North Dakota State Mill & Elevator, at Grand Forks, N. D., has been in operation for three years, and experience developed in the burning of lignite has been of considerable interest. Considerable steam is used in process and for building heating, and power is generated at low cost.

Plant Equipment

On the turbine floor are two 1,000-kw. turbine-driven generating units with two independent exciters, one motor driven for normal service, the other driven by a 55-hp. non-condensing turbine and used to supply additional steam to the low-pressure heating system and for starting when electric power is not available.

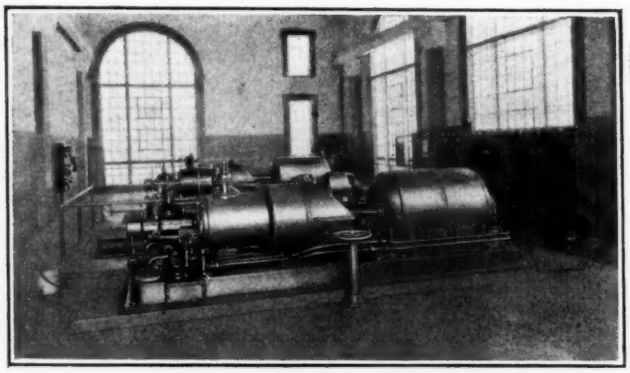
Low level jet condensers are used, and their tail pumps are equipped with dual drive induction motors and non-condensing turbine. A steam jet air evactor with a water spray intercondenser serves each unit.

The boiler room houses four boilers of 3,960 sq.ft. of heating surface each, with superheaters designed to give 100 deg. of superheat when the boiler is operating at normal rating. A five-retort underfeed stoker, fourteen tuyeres long, serves each boiler. Draft is furnished by turbine-driven forced-draft fans, two fans serving the four boilers.

Three boiler-feed pumps are provided, and the piping is so arranged that a change of pumps can be made quickly from the boiler-room floor. The pumps are located directly beneath an open heater, with a head of about 5 ft. on the pump sections. Feed-water regulators are fitted to each boiler.

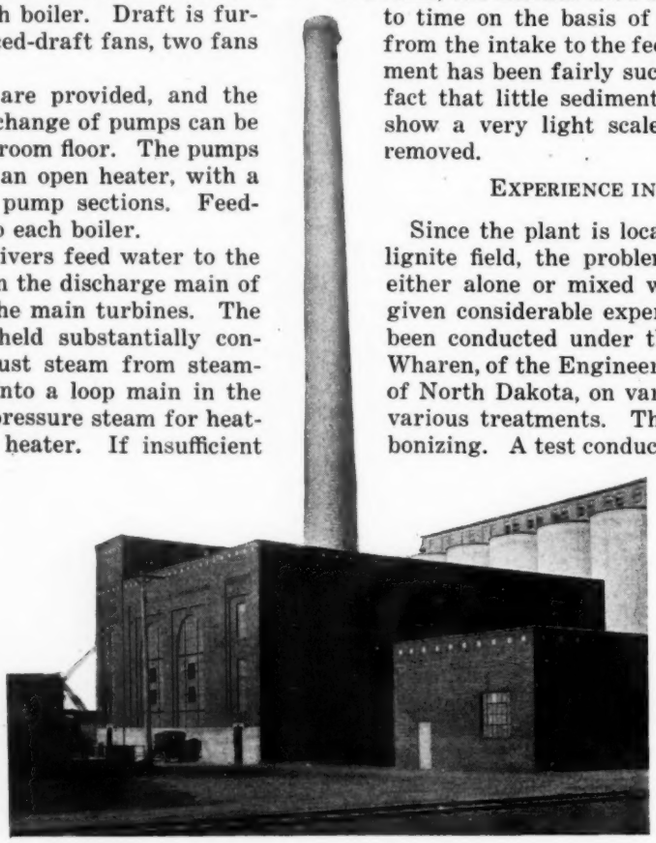
The service pump that delivers feed water to the heater draws its suction from the discharge main of the jet condensers serving the main turbines. The feed-water temperature is held substantially constant at 212 deg. F. Exhaust steam from steam-driven auxiliaries is piped into a loop main in the plant, and this supplies low-pressure steam for heating and for the feed-water heater. If insufficient exhaust steam is available additional steam is obtained by operating the steam-driven exciter at an appropriate load.

The main condensers are served by a spray cooling pond, makeup water being supplied to the pond from the city main. This water is rather hard, and considerable solid matter blows into the spray pond from the grain elevator and the coal storage yard. To counteract these conditions the water in the spray pond is treated with soda ash, lime and alum, the amount used being determined from time to time on the basis of analysis of samples drawn from the intake to the feed-water heater. The treatment has been fairly successful, as evidenced by the fact that little sediment is formed and the boilers show a very light scale, which is soft and easily removed.



Turbine room, with gage and switch panels

During the three years of plant operation these turbines have run continuously 24 hours per day, seven days per week, for six or seven months at a time without a shutdown. At the end of such long runs the casings have been opened and the blading has been found to be free from any scale or deposit.



Experience in Burning Lignite

Since the plant is located adjacent to the Dakota lignite field, the problem of using low-grade fuel, either alone or mixed with Eastern coal, has been given considerable experimental study. Tests have been conducted under the direction of Prof. G. B. Wharen, of the Engineering School of the University of North Dakota, on various grades of lignite, with various treatments. This includes drying and carbonizing. A test conducted at the plant to determine the relative merits of carbonized lignite in comparison with ordinary lignite screenings, in each case mixed half and half with Youghiogheny screenings, is reported in Table II. It developed that carbonized lignite is entirely unsuited for burning in this mixture on an underfeed stoker, due to the strong tendency to clinker formation. After a two-hour

run the furnaces were one mass of large clinkers, and, although the actual heat value of the fuel seemed higher than a mixture of ordinary lignite screenings and Eastern screenings, this clinkering tendency made it impossible to burn the mixture on an underfeed stoker.

With the ordinary run of lignite screenings, Washburn lignite worked out best in mixture with

TABLE I—SUMMARY OF OPERATING DATA FOR AN ACTUAL MONTH

Splint and Youghiogheny Screenings:	
Weight burned, lb.	1,213,575
Price per ton	$6.79
Lignite Screenings:	
Weight burned, lb.	1,070,223
Price per ton	$2.63
Total fuel cost	$5,527.43
Steam Distribution:	
To main turbines for power, lb.	8,921,370
To building heating, etc., lb.	2,054,500
To process service, lb.	606,400
Total commercial steam, lb.	11,582,270
To plant auxiliaries, lb.	5,936,930
Total evaporation, lb.	17,519,200
Total electric energy generated, kw.-hr.	582,700
Fuel cost per 1,000 lb. commercial steam	$0.4772
Fuel cost of steam to main turbines at $0.4772 per thousand lb.	$4,257.30
Fuel cost chargeable to electrical energy, cents per kw.-hr	0.731
Monthly averages:	
Evaporation, lb. steam per lb. coal	7.67
Boiler load, per cent of rating	120
Turbine steam rate, lb. per kw.-hr. generated	15.3
Cooling water intake temperature, deg. F.	76
Vacuum maintained, in. of mercury	27.2

Youghiogheny screenings or splint screenings in the proportion of half and half. Truax lignite screenings were a close second. The proportions of the mixture vary according to the analysis of the lignite. Each grade is sampled and analyzed as it arrives at the plant, and the results of these analyses dictate the proportions of the mixtures to be used. In a general way the mixtures vary from half to two-thirds lignite.

Lump lignite has been found unsuitable because of its high moisture content. A good deal of it passes through the stoker to the ashpit unburned.

Little clinkering results from the use of these combinations, and clinkers that do form are readily broken up. The air supply required to burn these mixtures proved to be somewhat of a problem and called for a little experimenting. Little trouble is now experienced in changing from one mixture or proportion to another, charts having been prepared to guide the operator. With a low ash content, or high moisture, more air is required.

Some attention has been given to over-fire draft, and it has been found that the best conditions result from the following values: Eastern coal, not mixed, 0.05 to 0.07 in. of water; lignite, mixed, 0.07 to 0.10 in. of water; lignite, not mixed, 0.15 to 0.20 in. of water.

TABLE II—TEST RESULTS

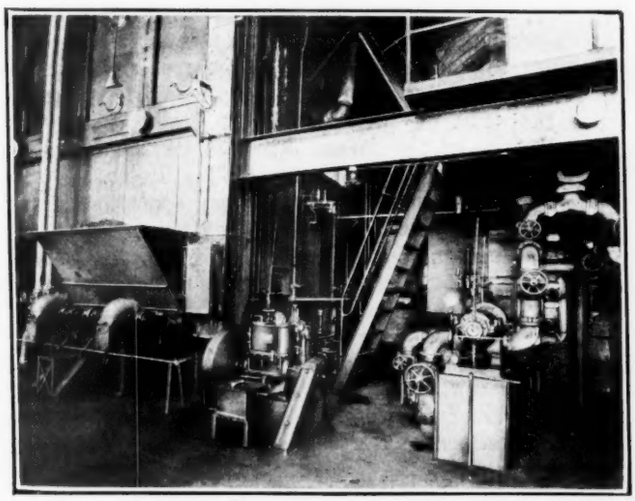
Carbonized Lignite Screenings Mixed Half and Half with Youghiogheny Screenings, Compared with a Day of Normal Operation on the Regular Mixture of Lignite Screenings Half and Half with Youghiogheny Screenings

	Carbonized Lignite	Raw Lignite
Duration of test, hr	7½	Operating Day
Youghiogheny Screenings:		
Weight burned, lb.	20,290	
Price, per ton	$6.44	$6.44
Cost for the run	$65.33	
Lignite:		
Weight burned, lb.	20,290	
Price, per ton	$5.00	$2.63
Cost for the run	$50.73	
Total Fuel:		
Weight burned, lb.	40,580	
Average price, per ton	$5.72	$4.54
Cost for the run	$116.06	
Water:		
Total evaporated, lb.	238,400	
Lb. water per lb. fuel	5.87	6.42
Lb. fuel per 1,000 lb. steam	170.2	
Relative efficiency, per cent	91.4	100
Price per ton of mixture for equal cost	$4.15	$4.54
Corresponding lignite price	$1.86	$2.63

Economy Results

The over-all plant economy is about 26,000 B.t.u. per kilowatt-hour, this figure being an average based on several months' operation and based on kilowatt-hours generated. This results in an average operating cost per kilowatt-hour of from 0.6 to 0.7c.

The summary of a recent monthly report, presented in Table I, indicates that the turbine steam rate is



A glimpse of the boiler room

Each pair of stokers is driven from a single line shaft driven by a steam engine, controlled by steam pressure regulators in conjunction with the stack draft control.

15.3 lb. per kilowatt-hour generated. This is an average figure covering normal operating load and is further substantiated by steam rate tests.

The operating and maintenance crew consists of three watch engineers, one on each shift, with one man firing, and one handy man who blows ashes, washes boilers and assists the general mechanic, who not only takes care of power plant repairs and piping but also looks after the steam pipe work of the mill and elevator. This makes a total of nine men chargeable to the power plant. It is claimed that this is the smallest operating and maintenance crew in any power plant of like capacity in the country, a fact that testifies to the efficiency of the plant layout and equipment.

TABLE III—TYPICAL ANALYSIS OF FUEL AS RECEIVED

	Moisture, Per Cent			Fixed Carbon, Per Cent	Volatile Matter, Per Cent	Ash, Per Cent	Sulphur, Per Cent	Heating Value, B.t.u. per Lb.	Price, Dollars per Ton	Cents per Million B.t.u.
	Air Dry	Oven Dry	Total							
Lignite:										
Washburn screenings	32.8	9.0	41.8	20.6	29.6	5.2	3.3	7,100	2.44	17.2
Truax screenings	22.0	5.4	27.4	22.6	26.0	22.2	0.8	6,500	2.63	20.2
Republic lump	20.0	14.6	34.6	21.9	26.4	15.9	1.2	7,260	2.57	17.7
Crushed mine run	24.6	10.9	35.5	17.3	27.3	19.0	0.9	6,590	2.63	20.0
Bituminous:										
Youghiogheny screenings	2.2	1.5	4.7	48.6	32.1	10.6	4.0	12,900	6.39	24.8
Splint screenings	2.5	1.1	3.6	53.3	36.2	5.9	1.0	13,950	6.44	23.1

High-Pressure Steam in Industrial Plants

By A. F. Sheehan

MOST engineers are convinced that there is a gain to be made by steam pressures as high as 600 lb. in industrial plants, but one or two drawbacks prohibit the adoption of high pressure, even though the power cost will be cut in half. The first obstable to overcome is the fact that no definite cost figures are available on the construction of small 600-lb. pressure engines of 500 to 1,000 kw. capacity. Next, what will be the life of such equipment, what is its maintenance cost, and will the steady supply of power be jeopardized in any way by the addition of the high-pressure units?

Obviously the easiest and cheapest way to secure the advantages of higher pressure in plants with a steady power and process-steam load is to use the present 125-lb. or 150-lb. engine equipment as the low-pressure side of the plant. These engines will take exhaust steam from the high-pressure unit instead of live steam as at present. But can steam be sent from a 600-lb. pressure boiler through a high-pressure engine or turbine and exhausted at 150 lb. to a standard-type engine with the same degree of dependability as when these engines receive the steam direct from the boilers at 150 lb. pressure? Undoubtedly this feature causes many plant owners to pause and wait for some one else to do the experimenting. Perhaps they feel that the manufacturer should have all the expense of the pioneer work, but in that case the selling price of the units must be sufficient to compensate him.

If the builders were assured of a market for their product, they would perhaps build small high-pressure boilers and engines at a cost comparing favorably with medium-pressure equipment. Of course what the plant owner can afford to pay depends upon what the saving will be.

Advantages When Process Steam Is Needed

The saving is a maximum in plants with a 24-hour load requiring process steam at pressures around 15 and 20 lb. gage. In many of these plants the pressure is so low that not over one-fourth the total power can be generated by expanding the process steam in a non-condensing engine and three-fourths must be generated by a condensing unit. In a plant requiring 1,000 kw., a 750-kw. condensing unit taking steam at 125 lb. is often required, as the ratio of power demand to process steam demand is high and this is an ideal opportunity for the use of higher pressures. In other plants the process steam is required at pressures of 40 lb. or over, and to operate their condensing units at this high back pressure would reduce their capacity by more than one-half, thus requiring the installation of extra units if byproduct power is to be generated.

Picture a plant having a 20x40-in. compound condensing engine using 15,000 lb. of steam per hour at 125 lb. pressure. Generating steam at 600 lb. pressure and 750 deg. would increase the power output by more than 60 per cent, so that the proposed high-pressure engine exhausting to the present high-pressure cylinder would give the required power and the exhaust would be at a high enough back pressure to use in process work. But any suggestion regarding the installation of this class of equipment will be met by two arguments that are hard to get around. First, what will this cost and will not the first few installations prove unreliable, so that the production loss from power interruption may exceed any saving in power and fuel costs? Second, if this plan is so practical, why have many industrial plants installed within the past year or two been limited to 200 lb. and even 150 lb. in some cases?

Regarding the cost of high-pressure equipment, I am of the opinion that it will be much less than may appear at first glance. In the case of the plant with a 20x40-in. compound engine, it often happens that the process-steam demand is as high as the steam flow, in this case 15,000 lb. an hour. The engine may be loaded to a point where no steam can be extracted from the receiver for process work and the only way any economies can be effected is by the purchase of new power equipment, either for higher pressure or, by using the same pressure, a non-condensing unit can be installed to carry part of the load by expanding the process steam from 125 lb. down to the lowest pressure that can be used in process. A unit with a cylinder large enough to handle 15,000 lb. of steam per hour at 125 lb., if of the four-valve or uniflow type, would cost at least $20,000 and would develop 400 to 500 hp. at 15 lb. back pressure. Operating 24 hours per day it could save its cost in about a year and a half. But a pound of steam at 600 lb. gage pressure and superheated to 750 deg. has less than a third of the volume of steam at 125 lb. pressure, so the cylinder size could be made much smaller at the higher pressure. If 15,000 lb. per hour is passed through a 20-in. cylinder at 125 lb. pressure, then only a 11½-in. cylinder is required at 600 lb., and why should it cost more to build a 11½-in. cylinder for 600 lb. than a 20-in. cylinder for 125 lb. pressure? The high-pressure cylinder of ordinary compound engines does not cost as much as the low-pressure, even though it must withstand 125 to 150 lb. and 350 deg. temperature, whereas the low-pressure cylinder operates at less than 15 lb. and 250 deg. temperature. This 11½-in. cylinder will replace the 40-in. low-pressure cylinder, but not necessarily connected to the same shaft, an independent unit being preferable. Due to the reduction in piston area, the frame and crank-shaft are not subjected to much greater thrust from 600 lb. pressure and 125 lb. back pressure than from 125 lb. initial pressure where equal power is developed at the two pressures.

Higher Installation Costs

The boiler plant will undoubtedly cost twice as much as for 125 lb., even though the size can be reduced one-half. The settings and stokers will cost less on account of the reduced size, but the pressure parts will cost three or four times as much per square foot, which makes the net cost of pressure parts about double, when allowing for reduction in capacity. Considering the reduced size of setting stokers and heating surface, the maintenance costs should not be any greater at the higher pressure. New tubes will cost more when replacement is necessary, but cost of cleaning and furnace upkeep will be considerably reduced.

Brightwood, Mass. A. F. Sheehan.

Pipe Joints for Gasoline at ordinary atmospheric temperatures can be made up tight by first filling between the screw threads of the pipe with a thin paste made of gum shellac dissolved in a 10 per cent solution of ammonia. The screw threads of both pipe and fittings should be thoroughly cleaned of grease before application of the paste.

Get Acquainted

NOW AND THEN a man finds another man "jumped" over him to a better job, and it is common for such a man to assume an air of injured innocence and complain loudly that in his organization the "plums" go to those in the good graces of the "big boss." This is very likely to be true, but it must be admitted by any fair-minded man that there are two sides to the question.

There are cases in which a man is advanced beyond the level of his ability for reasons unrelated to the business. Whether the reasons are politics or family or friendship, such a move is bad for the organization, hard for the men who are left behind and perhaps hardest on all for the man thus advanced.

But there is another case—a man of ability is picked for promotion, perhaps over the heads of more capable men. Why? Because he has a "pull" with the boss, some will say. But there is another way to put it that is more often true. The boss picks for promotion a man in whom he has confidence, and of course he has small confidence in a man he doesn't know. An executive seeking a capable member for his staff would rather pick a man that he knows has adequate ability than an unknown man alleged to have far greater ability.

For this one among many valid reasons, it is good to know your superiors personally. The association need not be intimate, and certainly must never depart from the realm of self-respect and mutual respect.

Know the men above and below you. Be friendly. It brightens the daily grind for everybody, and makes the plant run more smoothly. Incidentally, it is good business.

Inside Is Where Results Are Produced

A POWER PLANT that possesses architectural beauty is not in any way objectionable, if the features are not allowed to interfere with the utility value. The most essential function of a power plant that is worthy of the name is to convert the energy stored in fuel or falling water into a form that can be transmitted electrically and to do this in the most economical manner. After the engineer has completed his work of designing the plant, the architect, if given an opportunity, can at small expense improve its outside appearance without interfering with the general design of the building or the arrangement of the equipment, and this is a practice followed by some companies with satisfactory results.

In these days, when so much emphasis is being placed on efficiency of power plants and on providing means of operating them intelligently, to find a power station built at a large expense for architectural features while neglecting to provide the necessary equipment for obtaining an intelligent record of operation is almost unbelievable, but such travesties on economy do occur. The investment put into the outside of the plant can produce no return other than that intangible thing that may be had from looking at something that is pleasing to the eye. Expenditures made on the inside of the station to improve the efficiency and for obtaining an intelligent record of operation, when applied within economic limits, pay handsome dividends.

It therefore seems a paradox to find a modern business putting large sums of money into the non-producing end while neglecting the part where thousands of dollars can be made or lost each year. If the operators and their problems are neglected in the design of the plant, can they be blamed for not getting the highest efficiency in operating the equipment? It is a coal-weighing larry, steam-flow meters, CO_2 meters, thermometers, etc., that are among the real factors in getting results, and not fancy bricks or other architectural frills, although these can have a beneficial effect if applied with intelligence.

"Blind-Spot" Engineering

WRITING in last week's issue on the subject "Power Plant Opportunities," Lynn L. Armantrout told of a large factory where all the returns from factory units were drained into the sewer, in spite of the fact that heating and process steam and hot water represented more than eighty per cent of the fuel burned. The striking thing about this case was the fact that the plant was thoroughly modern in its general equipment. The use of stokers, uniflow engines and other fuel-saving equipment showed that the owners were both able and willing to make substantial investments in the interest of operating economy. Yet they failed to do an obvious thing and paid dearly for the oversight. The only reasonable explanation is that some one in authority—the owner, the operating engineer or the consulting engineer—had a "blind spot." Some things he (or they) saw clearly and others not at all.

One is not so shocked or surprised at the waste of fuel in a tumble-down plant where shreds of erstwhile insulation festoon the steam lines, while water drips and steam blows on every side. Operators who are content with such conditions—some of which, at least, must be their own fault—are not expected to exhibit any ambition or gumption beyond the minimum required to maintain a shiftless existence. But the occasional plant where the worst and the best practice are found side by side is a puzzle to the thoughtful observer. Unless he is already acquainted with the remarkable phenomenon of blind spots, he cannot understand how men who are in most respects thoroughly competent can now and then fail to see the obvious.

One of the most common blind spots is on the subject of process steam and byproduct power. There are still

some fairly respectable plants where one set of boilers supplies process steam through reducing valves while other boilers feed condensing engines or turbines. Reducing valves have their legitimate field of usefulness. The same, of course, applies to condensing prime movers, but only extraordinary circumstances can justify the combination just mentioned.

Again, a large manufacturing plant recently put in a battery of stoker-fired water-tube boilers to heat the factory. Everything from motor-driven forced-draft fans to coal- and ash-handling equipment was the very latest. Then they turned around and installed right beside this model boiler plant an equally well-designed substation for the purchase of a considerable amount of power for manufacturing. The golden opportunity to install an engine or turbine as a reducing valve on the heating mains and thus generate a substantial portion of the required power was completely overlooked. The additional investment would have been very small and the savings large. This single oversight wastes more than all the refinements can save.

Something More Needed Than Supposed Precedents

EVEN though the squirrel-cage type alternating-current motor is a criterion of mechanical simplicity, its application has led to many complications due to torque requirements, power factor, speed control, starting current, methods of starting, etc. For years the problem of the power factor of this type of motor and of how to maintain it within reasonable values has been the subject of voluminous discussion and is still a prolific source of debate. Now a second source of prolonged controversy is promised in the question as to whether a squirrel-cage motor requires a starter, and if it does, what type this shall be.

The auto-transformer has for a long time been considered a necessary adjunct to a squirrel-cage motor in sizes above five horsepower. Recent investigations have apparently raised doubts as to whether the auto-transformer is beneficial or detrimental in starting the motor. Other investigations have created apprehension as to the generally accepted superiority of the auto-transformer type of starter over the resistance type. As a result the whole question has been placed upon the anvil of debate to be hammered out by future experience.

If a squirrel-cage motor does not require a starting device, then the reduction in cost in motor installations and the increased simplicity dictate its abandonment, even if it has taken until this late day to find out that the auto-transformer appendage to the motor is unnecessary. Motors up to five-horsepower capacity have in general been started by connecting them directly to the line, but for machines larger than this it has been the practice to start on reduced voltage in order to keep down the starting current peaks, to limit line disturbances and, in some cases, to protect the motor winding and the driven machine.

There is apparently little doubt that the end winding of large-size induction motors can be braced so that they will stand across-the-line starting. Motors for this class of service have been built for a number of years and are apparently standing up as well as those that are started on reduced voltage. Therefore on this score there is little room for debate. There is frequently a lack of appreciation of the difference that exists between a large and a small system when starting a motor. A fifty-horsepower motor could be connected directly to a twenty-thousand-kilowatt station and its presence would scarcely be known, whereas connecting this same motor to a five-hundred-kilowatt station in the same manner would create a serious disturbance on the system. The same would be true in regard to the size and length of feeders. Another factor to be considered is the type of load the motor is starting. A load of small inertia or friction will cause much less disturbance than one of high inertia or friction. Further, most of the central stations have restrictions limiting the starting current that a motor can take.

The double squirrel-cage motor has been proposed as a means of eliminating the starting device. This type of motor has the objection of having a power factor lower than that for the single squirrel-cage type of the same speed. This solution is therefore something like jumping out of the frying pan into the fire, since even though it offers a means of eliminating the starting device, it promises to make the power-factor situation more serious than at present. The cost of the double squirrel-cage motor will be higher than that for the single squirrel-cage type. There is no doubt that all of the proposals have their place in the economic application of alternating-current motors, but the adoption of any one of them should be decided upon after careful consideration of all the factors involved and not by any supposed precedent.

To College Seniors

THIS is the time of the year when men in the senior classes of engineering schools begin to think seriously of the work they will undertake after graduation next June. The attention of such men should be directed to the opportunities available in steam power plant operation.

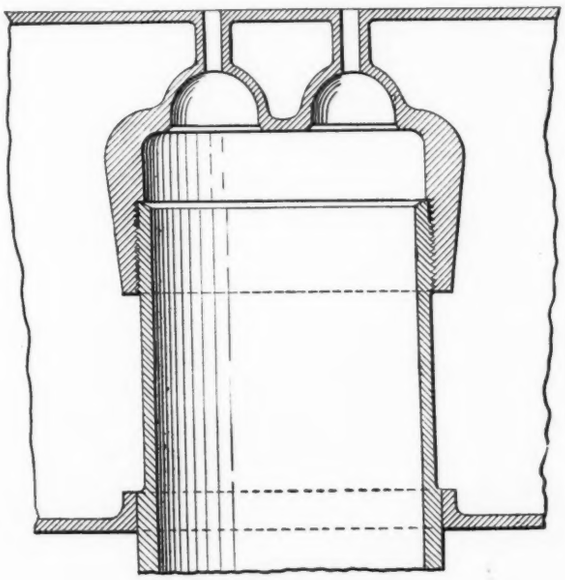
Many new steam stations of medium and large size have been built within the last few years, and many more will have to be designed and constructed if the demand for electricity continues to increase at the present rate. These new stations embody modern technical refinements and improved apparatus that enable the operators to secure maximum economy. The operation of such a station has become a highly technical job and calls for the best trained man available. The boiler room with its scientific means of control on which the efficiency of the plant largely depends, has become a huge heat transfer laboratory requiring technical skill and experience of a high order to secure the best results. Grimy, sweating firemen, shoveling coal into furnace doors, have no place in such a plant. Instead, an operator in clean overalls watches indicating and recording instruments connected to each boiler and from their indications makes such adjustments of the firing and draft apparatus as are necessary to secure the desired performance. These standards of performance are set by careful tests of various character made by one of the test engineers. Such modern boiler plants burn so much coal that it pays to employ one or more engineers to see that the utmost possible percentage of boiler efficiency is secured.

These plants offer splendid opportunities for college graduates to start their practical work and to learn the business. The expanding field of the central station industry will provide good jobs for many of these men in the future.

Practical Ideas From Practical Men

Expansion in Engines With Aluminum Cylinder Heads

Numbers of internal-combustion engines have been built in which the cylinder liners are of steel and the cylinder heads and water jackets are aluminum castings. It has often been argued that the liners on an engine of this type would leak badly when hot, due to the difference in expansion between steel and aluminum. A test was carried out on a cylinder head



Design of head and liner

of this type and the steel liner that fitted it to determine the differences of expansion at different temperatures. The cylinder block contained three cylinders, one of which is shown in the illustration, and this was carefully measured cold, as was also the liner, which had a bore of 5.7 in. The parts were then put in an oven and the temperature was brought up to 200 deg. F., at which time both were again measured. The temperature was then raised to 400 deg. and another set of measurements taken. The results of this experiment are shown in the table, in which the expansions are the amount of growth at the temperatures stated. The measurements *A* are taken parallel to the axis of the three cylinders, measurements *B* at right angles to these.

EXPANSION OF LINER

Cylinder No.	Position	Expansion at 200° F., In.	Expansion at 400° F., In.	Total Expansion, In.	Amount of Permanent Set, In.
Measured at Combustion Chamber End. Position 1.					
1.	A	+0.006	+0.015	+0.021	+0.002
	B	+0.002	+0.014	+0.016	—0.0015
2.	A	+0.007	+0.014	+0.021	None
	B	+0.006	+0.013	+0.019	—0.002
3.	A	+0.008	+0.011	+0.019	—0.003
	B	+0.007	+0.014	+0.021	—0.001
Average		+0.006	+0.0125	+0.0195	—0.0013
Measured at Jacket End. Position 2.					
1.	A	+0.009	+0.020	+0.029	None
	B	+0.006	+0.021	+0.027	None
2.	A	+0.007	+0.020	+0.027	—0.001
	B	+0.008	+0.018	+0.026	+0.001
3.	A	+0.008	+0.019	+0.027	+0.001
	B	+0.007	+0.016	+0.023	+0.001
Average		+0.0075	+0.019	+0.0265	+0.0005
Steel liner.					
	A	None	+0.010	+0.010	+0.0005
	B	+0.003	+0.010	+0.013	+0.0025

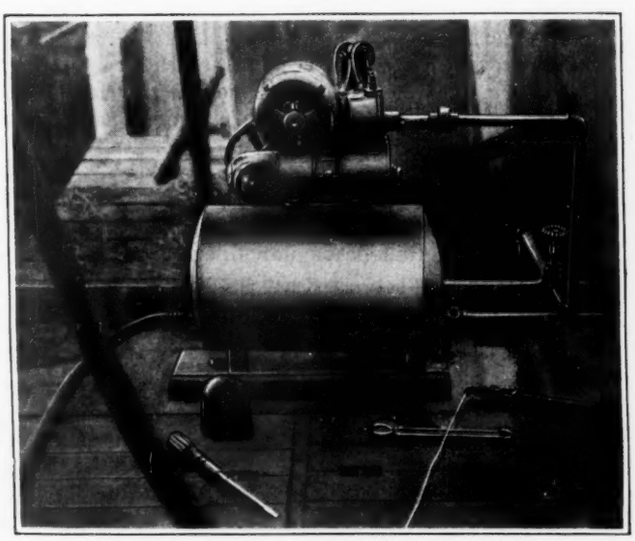
It would appear that at the ordinary water-jacket temperature the steel liner would be slack in the aluminum head, and that the liner would leak. This trouble can be obviated during manufacture by heating the head before screwing in the liners. The amount of shrink will depend on the diameter, but in this particular case it was found that 0.005 in. was necessary. Under these conditions there was no sign of leak with a hydraulic test on the liner of 400 lb. per square inch, but a much stricter test consists of filling the jackets with boiling water and testing to 30 lb. The metal-to-metal joint between the liner and head at the combustion chamber end can, with advantage, be chamfered inward toward the center as shown. This makes a much more satisfactory joint than the flat-face type for high pressures.

DOUGLAS P. MUIRHEAD.
Glasgow, Scotland.

Removing Air Agitation Needles

As is well known among refrigerating engineers, air needles are best removed from the frozen ice can by water pressure rather than by using hot water. The quantity of water needed is small, but many plants do not have it at sufficient pressure. In the ice plant of the Florida Power & Light Co. at Fort Lauderdale, Fla., a small household water tank and pump, shown in the illustration, were installed for this purpose.

The pump, which is a double-acting piston type, is driven by a $\frac{1}{6}$-hp. motor and is mounted upon a small



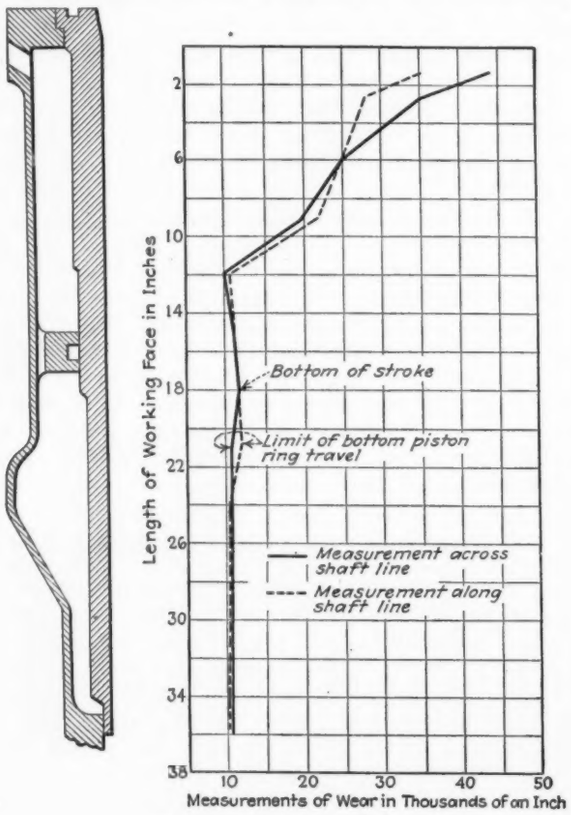
Pump removes air agitation needles

galvanized water-storage tank of about 10 gal. capacity. The motor has a pressure-controlled switch and as soon as the water and air in the tank reaches 30 lb. per square inch pressure, the motor circuit is broken and is restored when the pressure drops to 20 lb. The outfit works satisfactorily and is much cheaper than an overhead tank used in many plants. L. H. MORRISON.

New York City.

Why a Diesel Engine Piston Seized

Two slight mysterious piston seizures in the same cylinder liner of a Diesel engine caused me to give the matter serious consideration. They were mysterious because at the time there appeared to be nothing in



Wear of piston and liner

the lubricating system or in the state of the fuel or exhaust valves that would account for them.

I had been given to understand that such seizures were not uncommon in old or worn liners that possibly had not been disturbed for years. It was also known that excessive strain was almost always necessary to remove the liner for the annual inspection and cleaning.

The graph shown in the illustration is from measurements taken on this particular liner, which has been in service for about 15 years in a four-cylinder 200-hp. four-stroke-cycle air-injection Diesel. Particular attention is called to the shape of the wear curve opposite a point about 12 in. down the working face. It will be seen that the point of bulging is at the reduction in the outer diameter caused by turning down the liner to form the middle belt.

It is probable that the curve submitted bears little resemblance to the shape of the liner bore under working temperatures; but assuming that the liners in course of time become more or less held at the belts, causing increased wear as shown when measured cold, the part above the belt, being also restrained from longitudinal expansion, would at the same time tend to bulge more and more as the working temperature increased. If the conditions were favorable, a sudden increase in load or a load above normal would bring about a piston seizure.

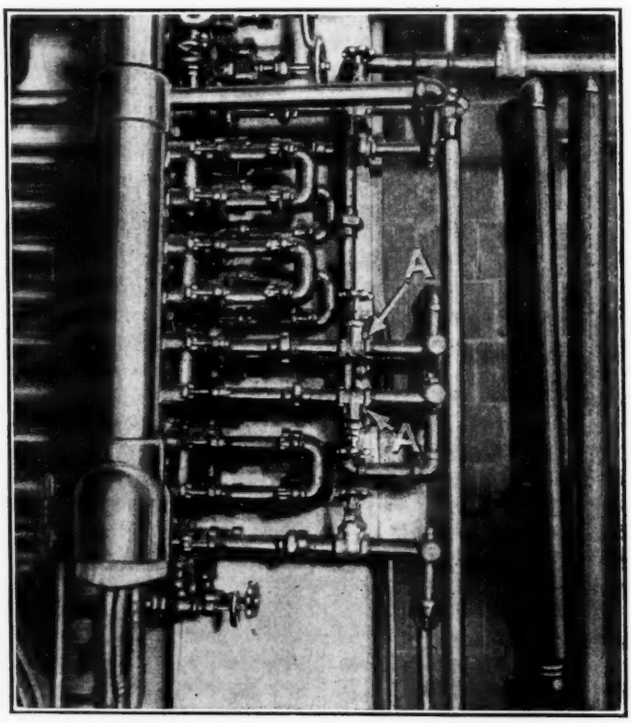
As evidence that it is liner more than piston distortion that causes these unaccountable seizures, let it be noted that the zone of seizure on the piston was about 11 in. below the top ring. In the liner referred to, the engine stroke is 18¼ in., so that the seizure zone on the piston at the bottom of the stroke would be 27 to 30 in. down the working face of the liner. As will be seen from the liner curve, the clearance due to wear here is very small, yet the worst effects were found to be about or above the middle belt where the clearance due to wear is greater. JAMES M. BLOOMFIELD.

Kamsack, Sask., Canada.

Reducing Power Used by Condenser Pump

It is seldom that a refrigerating plant has a winter load that approaches its rated capacity. The amount of water needed on the condensers then is much less than the summer demand, and it is usual to operate the circulating water pump at slow speed, in case it be a piston-type machine.

However, the pump must force this water through all the coils of the condenser and the pumping head is much greater than is necessary, as only part of the coil surface is needed when operating at a low refrigerating capacity. In one plant bypass valves, *AA*, as



Condenser has bypass water valves

shown in the illustration have been placed on the coils of a double-pipe condenser. By opening these valves the water is forced to flow through only a part of the condenser coils and the pumping head is correspondingly reduced. This same plan has been used with centrifugal pumps. JAMES CASE.

Atlanta, Ga.

Comments from Readers

Purchase of Coal on Specification

I read with the greatest interest H. D. Fisher's letter in the Feb. 2 issue on "The Purchase of Coal on Specification," and must confess that I cannot see the validity of his argument. Any ore mine is in just the same condition as the coal mines, but nevertheless nobody thinks of buying ore per ton without considering the quality, and why should the situation be different for the coal mine?

Probably the ideal solution would be to sample all coal regularly at the pit head and classify it accordingly. The sampling could be done mechanically at reasonable cost and with high accuracy, but this would require co-operation of buyers and miners, which may not be easily obtained. OTTO KAHRS.

Oslo, Norway.

A Substitute for the Crank

In the March 2 issue the article "A Gearless Reducing Gear" under "What Happens And Why" brought to mind some of my earlier experiments.

In a small handbook published by one of the scientific magazines during the '80s, there appeared a picture of a device much like the "gearless reducing gear." It was called "a substitute for the crank." The disk wheel of the driven shaft in the reducing gear corresponds to the crank wheel in the accompanying sketch of this old device. The two slippers were pivoted to the connecting rod as shown.

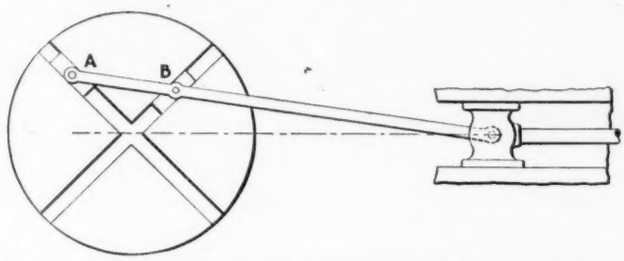
I was just old enough at the time to be inquisitive in mechanical matters, but did not have the knowledge to understand or figure out the mathematical reason why such a device should or should not work. I could not believe that, if these two slides or slippers were pivoted to the same rigid connecting rod, the disk wheel would even be free to turn, to say nothing of the push of the rod being able to turn the wheel.

I had to confer with my older brother and express my doubts to him as to the possible performance of the device. He, of course, ridiculed my idea that it would not work, although I am not sure yet whether or not he then saw just why it would work.

At any rate, I had a wooden engine, the boiler of which was whittled from a stick of stove wood and the working parts from pine lath. Not until I had also whittled from the pine pieces a working model of the new crank and placed it on the shaft of my toy engine was I convinced that it would work. But it did work! Those little slippers flew back and forth across the disk as though they were the whole show. Although one knew differently, he would almost be convinced that the slippers were working the connecting rod.

I remember that I had much difficulty in connecting the slippers to the connecting rod at such points as to allow the disk wheel to revolve until I discovered a simple method. This was to set the cross-head of my engine at the out center and then connect the slipper *B* while it stood at the exact center of the disk wheel. The cross-head was then moved to the inner center and the rod connected to slipper *A* while it stood at the exact center of the disk. In other words, the distance from pivot of one slipper to the pivot of the other must equal the stroke of the engine.

The practical use for such a device as a substitute for a crank never passed my youthful inspection, because it was too complicated for my simple wooden parts to hold together. It has never received my sanction at any time since. I feel that the gearless reduction gear will never get any further than did this crank in the mechanical power field. Although it is a very ingenious device, the cost of production, the space to mount, the complication of its parts and its limited reduction (compared with the simplicity of a pair of gears) puts it out of consideration, in my opinion, as a modern power-transmission unit.



Sketch of crank substitute as applied to model engine

North Bend, Neb. GEORGE B. MCVICKER.

[The device shown combines a crank effect and a "reducing gear." Study will show that it takes two complete back and forth movements of the piston to produce a single revolution.—EDITOR.]

Insurance and the Maintenance of Electrical Machines

It has been asserted several times that an insured object is regarded by the insurance company and the operating company from two widely divergent points of view. In the case of electrical machines, this is obviously not so. Both companies demand that the machine shall be maintained in good condition and properly protected. Proper maintenance results in lower operating costs, reliability of service and, finally, reductions of premiums to the operating companies due to a decreasing number of accidents. It reduces the loss ratio and means a relatively safer risk to the insurance companies. Poor and insufficient maintenance decreases efficiency and ultimately leads to failures. Breakdowns result in disruption of service with attendant inconvenient loss of time and money, excluding that amount for which the insurance company is liable, unless a use and occupancy policy is held. This loss of time and money in the form of additional correspondence and time lost by employees and machines being idle cannot reasonably be dismissed.

Electrical machines are rated according to type, volt-

age, speed and capacity. Age or the condition of the machine has no effect on the schedule of rates. For this reason insurance companies usually employ electrical engineers who make periodic inspections of the machines with a view of improving their operating conditions and care and to determine if the risk is a desirable one. They also co-operate with the operating company's engineers, with the result that quite frequently valuable ideas for improvement and maintenance are suggested. The utilities and larger industrial companies take relatively good care of their equipment. It is the smaller companies that are somewhat slack in this respect. This is caused either by the negligence of the management or the lack of knowledge of the responsible employees as to just how important this work is. From these considerations it is evident that the insurance company and the operating company can be of great assistance to each other.

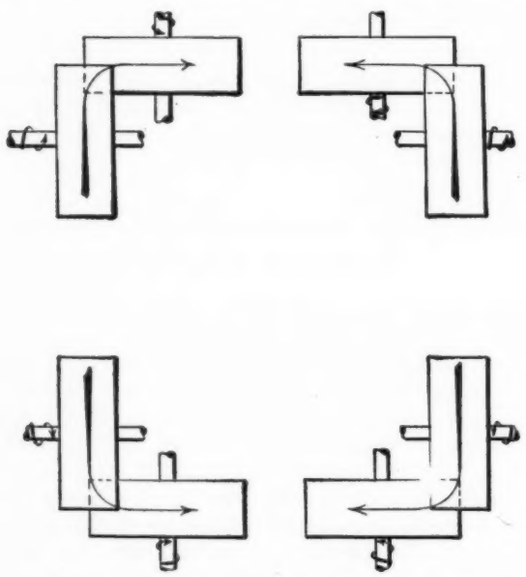
Operating and insurance engineers, both being interested in proper maintenance of the insured equipment, will do well to review continually those items necessary for continued satisfactory operation of the machine.

CLAIR L. KEENE,
Field Engineer,
New York City. Columbia Casualty Company.

The Quarter-Turn Belt

The article on "Quarter-Twist Belt Drives" on page 426 of the March 16 issue brought to mind a simple rule for laying out such drives.

Some years ago I had occasion to make layouts for big car shops and other plants where wood-working machinery was used, and there was a constant struggle in setting the machines at the proper place in reference



Pulley setting for quarter-turn belt drives

to the driving pulley, using a quarter-twist drive. In laying out such a drive all one has to observe is the fact, by looking down on the top of the two pulleys, that the arrow of direction of the upper pulley follows the arrow of direction of the lower pulley. The accompanying sketch illustrates the application of that rule for all four cases and is easy to follow.

Peekskill, N. Y. E. BUNZEL.

Power Costs

On page 351 of the March 2 issue are some interesting items of expense in connection with the New York Edison Co. The report shows, for instance, that the company's "regulatory commission expenses" amounted to $801,264.47 in 1924 and to $2,647,869.04 in 1925.

In order to obtain a supply of electricity for a community in the most efficient manner and at the least cost, it has seemed best to allow one company to handle the business and to give that company a monopoly in its field. It was thought that such a procedure would save the duplication of equipment and tend to better service. At the same time it was realized that such a company should be placed under some restrictions and that its operation should be supervised by some governmental agent; hence the establishment of our public service commissions. In many cases these commissions have protected the public from grasping companies and exorbitant rates and, on the other hand, have protected the companies from unreasonable demands by the public; but when one such commission places a burden of $2,647,869.04 upon a company in one year, it would seem as though we had made a mistake in selecting the commission. The figures mean that 4.6 per cent of the entire revenue of the company was spent for "commission expenses," and this would seem to be beyond all reason.

Another item of expense was $10,000 in 1925 for "appraising land owned by the company." This is not only an unwarranted expense, but it indicates that the commission allows the company to capitalize the appreciation of land values, which is not accepted as good practice. The original cost of the land is the only value that should be allowed for it while it is on the company's books and used and useful in the business. Any appreciation of value, which may be indicated by the market price, has been produced by the public and the public should not be called on to pay a standing charge upon it in the rates or otherwise. C. W. WHITING.

Boston, Mass.

Writing Yourself to the Fore

The letter by C. M. Durgin in the Dec. 29, 1925, issue, entitled "Writing Yourself to the Fore," has caused considerable interesting discussion in the succeeding issues of *Power* and I should like to add my experience to the discussion, as it answers some of the objections brought forth.

My case starts with a chance acquaintance in 1921 with a man looking for answers to a number of questions submitted to him from the readers of the magazine of which he was managing editor. In the course of our conversation I was able to give him considerable data, which resulted in my being asked if I had ever written for any magazine. The reply being in the negative, I was urged to try.

This brought forth the reply that I couldn't write, the management wouldn't permit it, etc., but at last I was prevailed upon to try one small contribution. This was done and was published under a nom-de-plume, and finding it easy and highly interesting as well as instructive, I was soon able to have a short article about twice a month in a weekly magazine.

At this time I took the matter up with my superior

and was told to use my own name in conjunction with the company's and if I needed any help, I was to ask for it and it would be forthcoming.

That is the attitude I have found in the Westinghouse Electric & Manufacturing Co. toward their employees writing for publication.

It is true that all material submitted to the press is checked by others. This is correct practice, as it prevents information being given out that would be in the nature of trade secrets, but this censorship does not in any way hamper a man that wants to try—in fact, I have had many helpful hints given me for additional material from the parties through whose hands the material passes.

The censorship board consists of representatives of the patent department, engineering department, sales department and publicity department.

The foregoing will help answer some of the points brought out in the letters commenting on Mr. Durgin's article.

I should also like to mention that the magazine articles gave me considerable help when I was starting in the electrical game and for that reason I like to pass on any little helpful data that I can through the medium of the press.

Any man writing for publication will tell you that it is another means of self-education, as one does not realize the small points that come up upon which a writer has to check himself.

So, taken all in all, writing for the trade magazines is made easy for anyone who has something to say that will benefit others, as the editors and others are willing to help. Anyone who reads a trade magazine and gets any hints from it and who has in his head some useful data or kinks, etc., has a duty to his fellow men to pass them on.

Thus any man can follow Mr. Durgin's precepts and "Write Himself to the Fore." A. C. ROE.

Wilkinsburg, Pa.

Exhaust Steam Versus Live Steam for Heating Purposes

The subject of exhaust steam versus live steam for heating has been discussed pro and con in the engineering journals for years with various opinions as to which method of heating is more economical.

Engineers have offered proof by giving figures that they are heating buildings more economically with steam after passing it through a prime mover of some description than they can by steam direct from the boiler after passing through a reducing valve. Such an article will be found in the November, 1915, issue of *Power*. These figures, however, are not conclusive proof that such is the case, because the most important factor in heating—that of wind velocity—is ignored.

It is easily possible to heat a group of buildings today with fewer pounds of exhaust steam than you may use to heat the same buildings tomorrow with live steam, outside temperature on the two given days being equal. The same advantage may be obtained with live steam over exhaust if no mention is made of wind velocities on the two days.

All engineers will agree that it takes less steam per hour, whether live or exhaust, to heat a building at zero outside temperature with no wind blowing than it will to heat the same building at many degrees above zero and a high wind. However, in all the proof so far offered to show that exhaust steam is better for heating than live steam, the factor of wind velocity seems to have been ignored.

It is often stated by those in charge of heating systems that they find it easier to heat buildings during the week when they are using the exhaust from the engines than it is over Saturday and Sunday when the engines are shut down and live steam only is used. But do they take into consideration the fact that an adult person gives off approximately 400 B.t.u. per hour and that the presence of several hundred people in a building adds materially to the reduction of steam consumption?

During Saturday and Sunday the buildings are occupied only by the watchman, and the heat generated by most watchmen in making their rounds may easily be ignored.

In low-pressure steam at, say, 2-lb. pressure, a heat unit is a heat unit whether it be taken from live or exhaust. The difference between saturated and slightly superheated steam at that pressure may be neglected, the principal source of heat in either case being when the latent heat of evaporation is given up.

John G. Smedley, Jr., in his discussion of the subject in the March 16 issue got us all worked up to the point in his proof that the results would be better with exhaust than with live steam and then for some reason or another failed to mention the answer.

He says he is convinced that much of the live steam returns to the heater before it is condensed. Such could not be the case if the system of trapping the condensation were efficient, as no steam should leave the system until condensed other than a small amount that passes through the traps when they discharge, and this should quickly condense when it reaches the lower temperature of the return system.

It is true that live steam returns are generally a few degrees higher in temperature than the returns from exhaust steam, but this in turn is reflected in a higher feed-water temperature to the boilers and should not lead to a higher steam consumption.

As a comparison let us take live steam at 80-lb. pressure and pass it through a reducing valve to 2 lb. In rushing through the valve the flow of steam is violently disturbed, but after reaching the larger-sized mains at a lower constant pressure it flows along like a couple of chips in the current of a passing stream. The only disturbance the steam flow undergoes on its way through the heating system is its change in direction by its encounter with steam fittings. The temperature of the heating surface and the rate of condensation remain uniform for a given temperature as long as a given pressure is maintained.

Compare this steam flow with that of exhaust steam leaving an engine at, say, 2-lb. back pressure. Due to the cut-off of the steam by the valve of the engine at each stroke, the steam flow is interrupted as many times per minute as the engine makes strokes. It is this pulsation of the steam flow that permits more of the steam in the system to come in contact with the radiating surface than would be the case if the flow were not interfered with.

It is this difference of application of the steam flow that permits us to derive greater results from a pound of exhaust than from a pound of live steam in this particular part of its journey through the cycle, but we must not lose sight of the fact that we have taken

some of the heat units from the steam in its passage through the engine and that the condensation will contain fewer heat units upon its return to the heater or receiver than will the live steam.

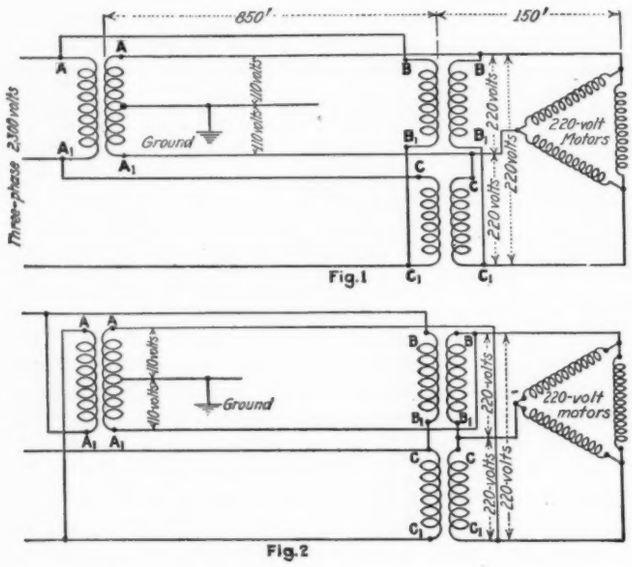
It would be interesting to be enlightened by engineers who have had experience with steam for heating from bleeder-type turbines as well as that from reciprocating engines to determine if there is any advantage to be gained in using one type of prime mover over the other.

L. H. STARK.

Milwaukee, Wis.

Delta Connection of Transformers

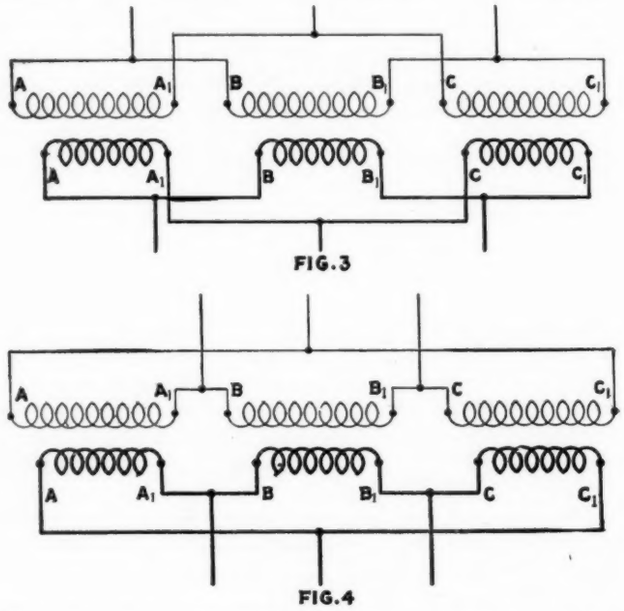
Referring to the criticism by Harry J. Achee in the Feb. 9, 1926, issue, of the diagram of transformer connections that accompanied my article under the heading "Why Induction Motors Failed to Start" in the Dec. 29, 1925, issue, I accept the criticism in the spirit in which it was no doubt offered. My diagram was not as simplified as I probably should have made it, and may have been misleading to Mr. Achee. However, the diagram as shown in my original article, and reproduced in Fig. 1, is correct. A careful comparison of the connections in Fig. 1 with the more conventional representation of closed-delta transformer connections in Fig. 3 will show that they are identical. Although some of the primary and secondary connections have been crossed from that in the usual connection, the diagram is nevertheless a true delta connection. This method of connecting the transformer was adopted, as it made a more simple arrangement of connections for the way the transformers are located in Fig. 1.



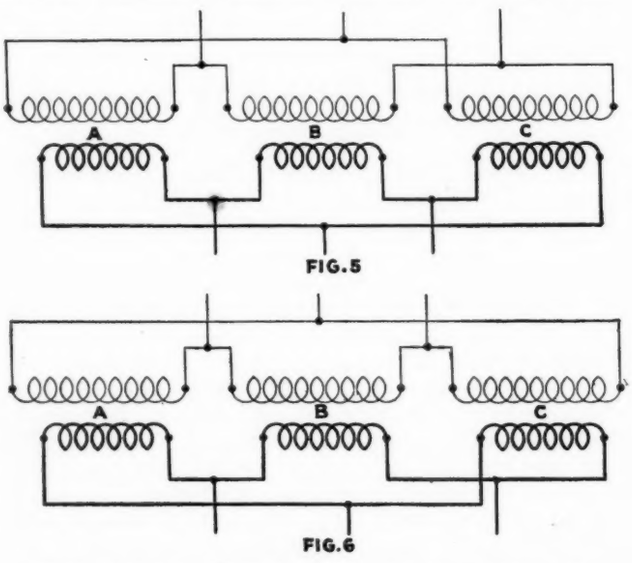
Figs. 1 and 2—Two ways of connecting three transformers in closed-delta

Mr. Achee's diagram, Fig. 2, is also correct in so far as a workable circuit is concerned, but he has complicated it somewhat by reversing both the primary and the secondary leads to transformer *A*. The transformers are connected according to the usual diagram, Fig. 4, but when this connection is followed out when the transformers are arranged as in this particular case, the connection becomes somewhat complicated and gives the appearance of the primary and secondary of transformer *A* being crossed.

In the foregoing it is assumed that the three single-phase transformers of the bank are each of the same relative polarity, which I believe is true of all modern standard transformers. In the earlier days of alternating-current distribution there was at least one make of transformer with which I am familiar, in which the polarity relations between the primary and secondary terminals was opposite from that which is now the accepted standard practice. Should one such transformer be connected in closed-delta with two others of different relative polarity, the connections would necessarily have to be as shown in Fig. 5 or in Fig. 6, where transformer *C* is assumed to be the odd transformer.



Figs. 3 and 4—Simplified diagrams of Figs. 1 and 2 respectively



Figs. 5 and 6—Closed-delta connections where the polarity of transformer C is different from that of transformers A and B

Clayton, N. M. J. H. BENDER.

New and Improved Equipment

Riley "Atritor" Unit Coal Pulverizer

In the Dec. 8, 1925, issue, a general view and brief description were given of the unit coal pulverizer known as the "Atritor" now being manufactured

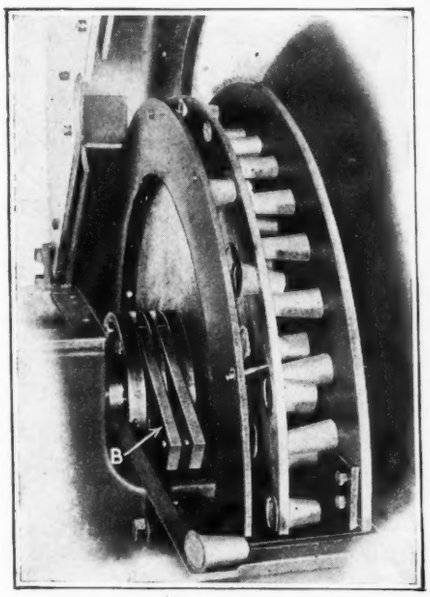


Fig. 1—View showing secondary pulverizing element

by the Riley Stoker Corporation, Worcester, Mass. Further details are presented herewith.

The pulverizer consists essentially of a feeder equipped with a magnetic separator, primary and secondary pulverizing chambers and a fan for discharging the coal and air to the furnace. The magnetic separator is incorporated in the feeder to remove tramp iron, in cases where no magnetic separator is included in the coal-handling equipment of the plant ahead of the pulverizer. The feeder is of the disk type and is readily adjustable for any load rating desired.

From the feeder the coal drops into the primary pulverizing chamber, in which the pulverizing elements consist of a series of swing hammers *B* pivoted to the rotor hub. These hammers take a radial position due to centrifugal force when the machine is in operation. In passing through the pulverizing chamber the coal is reduced to sufficient fineness to be carried over to the secondary chamber by the current of air drawn through the mill by the fan, the path of the coal and air between the stages being around the outside of the revolving disk *C*. The stationary renewable grid *D*, which incloses the primary chamber, is cut away at one point to take care of any tramp iron that might get by the magnetic separator and enter the mill with the coal.

The pulverizing element in the secondary chamber consists of alternate rows of moving and stationary pegs. The moving pegs are carried on the revolving disk *C*, the general arrangement being shown in the sectional views Figs. 2 and 3.

On leaving the secondary chamber the mixture of coal and air pass through the rejector *E* which throws the heavier particles of coal back into the pulverizing compartment for further grinding. When the coal has been reduced to the proper fineness it passes with the air to the fan *F* and is discharged to the burner at the boiler furnace. The fan which is located in a separate housing and is of special design furnishes approximately 10 per cent of the air required for combustion, the remainder being induced at the burner and under control of the operator. The shaft that carries the pulverizer elements and the fan is of large diameter and is carried in radial roller bearings.

The burner that has been developed for use with the "Atritor" has been designed to eliminate as far as possible

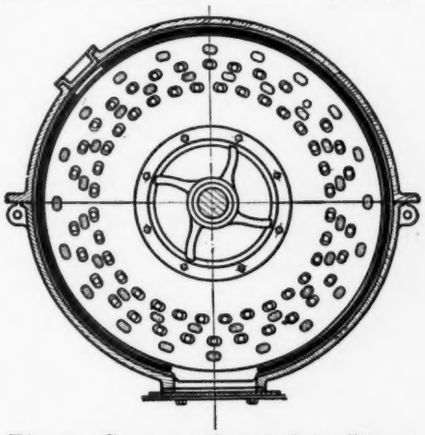


Fig. 3—Cross-section A-A in Fig. 2, through secondary pulverizing chamber

the stratification of the gases within the furnace. As previously mentioned, 10 per cent of the air required for the combustion of coal is supplied to the burner with the coal; the remaining 90 per cent is introduced at the burner through a series of vanes that tend to give it a swirling motion and cause it to be mixed thoroughly with the fuel. The mixing is further assisted by the use of adjustable baffles at the end of the burner nozzle.

In operation of the "Atritor" there are but two controls that require attention, one being the control at the coal feeder, which may be indexed to correspond to any load rating, and the

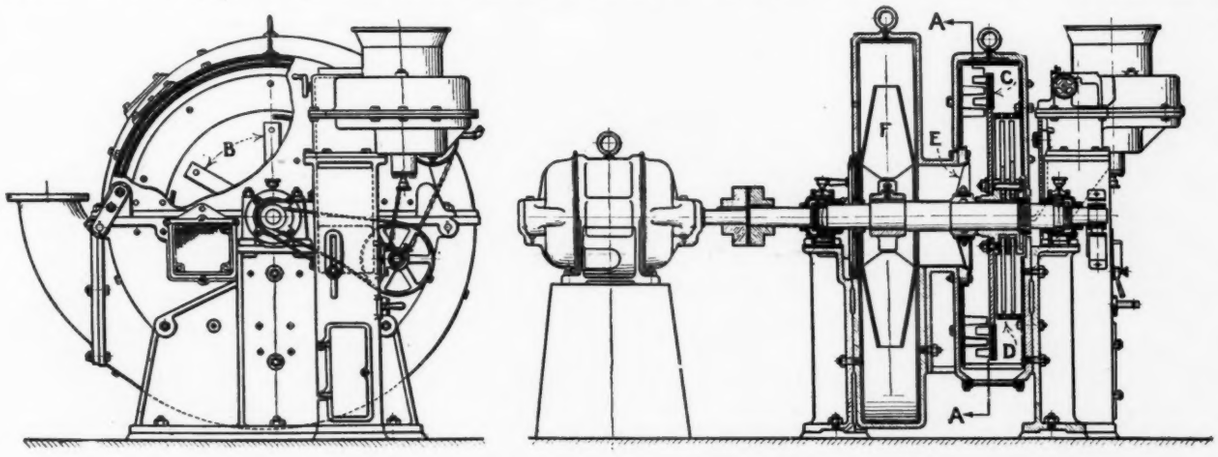


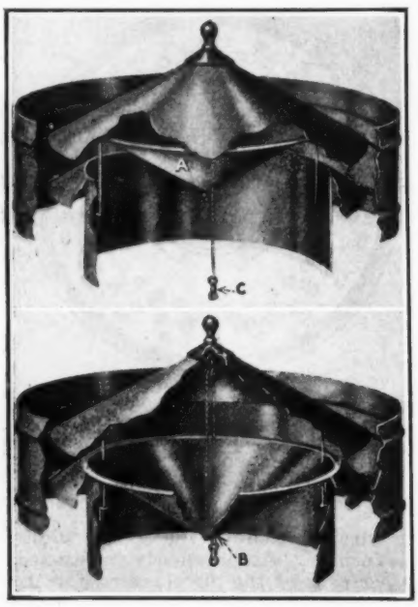
Fig. 2—View from feeder end of pulverizer and cross-section showing arrangement of pulverizing elements and fan

other the control of the air, which may also be indexed according to the load rating or in direct relation to the amount of coal being fed to the machine.

The pulverizer is at present made in capacities from 1,500 to 6,000 lb. per hour. Larger machines are now in course of development.

Burt Cone Damper Regulator

The Burt Manufacturing Co., Akron, Ohio, has recently extended its line of ventilators by the addition of the cone



Ventilator with damper in open and closed position

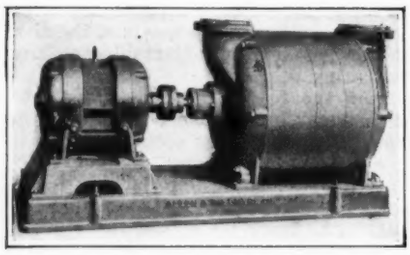
damper ventilator shown in the open and closed positions in the illustrations.

The general construction of the ventilator head is similar in many respects to other types of ventilators made by this company, the new feature being the employment of the cone-shaped damper *A*. The damper is operated by a chain as shown and is held in any desired position by slipping the chain into the elongated slot *B*. In cases where it is desirable to have the ventilator close automatically in case of fire, the elongated slot is omitted and other means provided for securing the chain through the fusible link *C*.

The design of the ventilator provides for a clear opening in the pipe or air shaft below the damper, there being no braces or louvers used on the inside. The type of ventilator illustrated is furnished in sizes from 10 to 72 in. made of heavy galvanized steel, or can be furnished from any other material specified.

Pneumatic Cleaner for Use in Industrial Plants

A dirt-removal system that removes, conveys and collects dust in one operation has been designed and placed in operation by the Allen & Billmyre Co., Inc., of New York City. This system, electrically operated, is called the "Tabco," and performs its work without spreading or raising any dust in the atmosphere. In operation it is simple, for it acts similarly to the ordinary household vacuum cleaner, differing only in that it has a much larger capacity. Multi-stage centrifugal blowers and exhausters, driven by Westinghouse motors, are used, and the equipment is made in a wide range of sizes



Exhauster driven by a 40-hp. motor

and capacities in units of ½ to 50 hp. The figure shows a 40-hp. unit installed in the Sherman Creek plant of the United Electric Light & Power Co., New York City.

The outstanding feature of this system is that no dust is raised during the operations. For this reason it finds particular use in the textile industry, where dust tends to clog the machinery; in the lead industry to eliminate the poisonous dusts; in the wall-paper industry and the silk mills, where dust injures the products, and in grain elevators, starch factories, coal-pulverizing plants and hard-rubber plants, where dust accumulations are the occasion of serious explosions. It has also been found useful in power plants, the dust being easily and quickly removed from the tops of the boilers and from boiler exteriors, piping and other structure, and lifted to an overhead collector, from which the combustible material is delivered into hoppers to be burned. This system is safe and meets with the recommendations of the National Fire Protection Association for minimizing dust explosive hazards.

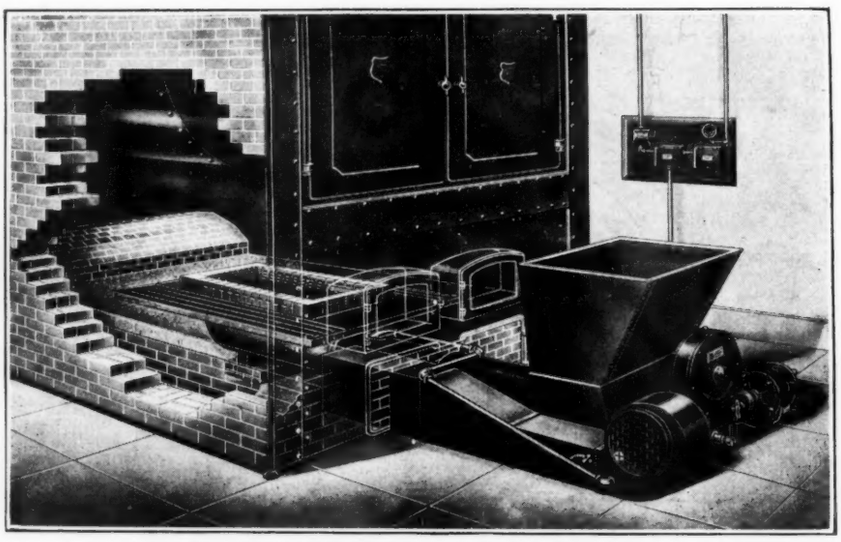
The Iron Fireman

While the "Iron Fireman," a complete underfeed stoking unit for small power and heating boilers, originated in Portland, Ore., some eight years ago, it is only recently that this stoker has been introduced to the eastern section of the country by the Iron Fireman Corporation. Chicago is one of the large distributing centers, the local address being 617 Fulton Street.

As shown in the accompanying illustration, the stoker is of the single-retort type equipped with a multi-vane fan and screw feed for the fuel, both being driven under automatic control by a single motor, so that the air supply and the fuel feed are regulated in unison. The fan is directly connected to the motor, and the screw feed is driven from the motor shaft through a worm gear and ratchet. There is manual adjustment to give five rates of coal feed and a damper in the air duct near the fan to vary the supply of air. The automatic control starts and stops the motor within predetermined limits of steam pressure. The small pipe leading from the fan discharge introduces a positive pressure in the feed-screw housing to prevent any flow of gas back through the fuel hopper.

The installation shown is under a return-tubular boiler. The grates have been removed and the stoker unit slipped into place, with the retort at the center of the combustion chamber. Iron dead plates along the sides and across the ends of the retort receive the fuel overflowing from the central feed and seal off the ashpit, so that the air for combustion must pass through the air slots in the tuyere blocks on all four sides of the retort.

The stoking units are made in six different sizes to serve boilers having 50 to 1,500 sq.ft. of surface. The largest has maximum capacity to feed 1,000 lb. of coal per hour, which by regulation may be reduced to a minimum feed of 200 lb. per hour. These figures may be compared to 50 and 10 lb. per hour, respectively, for the smallest of the six sizes, the latter being used only for small heating boilers.



Iron fireman installed under return-tubular boiler

Recent Publications

High-Vacuum Surface Condensers. By D. T. McHutchison. The Association of Engineering and Shipbuilding Draughtsmen, 96 St. George's Square, London, S. W. 1. Paper; 5½x8½ inches; 44 pages. Price 2 shillings.

This is one of a series of printed lectures on various technical subjects, addressed to draftsmen and junior engineers. In this pamphlet Mr. McHutchison sets forth in an interesting way the considerations involved in the design of surface condenser equipment, and presents a number of curves and tables exhibiting experimental results. The method of presentation is clear, and the reader is not assumed to be exceptionally well prepared mathematically. The booklet should be valuable for draftsmen concerned with the layout of condensers and for operating engineers who desire to learn more about the factors involved in condenser operation as well as others interested in the subject.

Relay Handbook. Published by the National Electric Light Association, 29 West 39th St., New York City, 1926. Flexible binding; 4½x6½ in.; 1,001 pages; 749 illustrations; 55 tables. Price per single copy, $4 to members and $6 to non-members. Reduced prices for quantities. Member price is allowed to A. I. E. E. members and students.

Relays may be considered the brains of the power system, for it is to them that the effects of a disturbance are transmitted and they in turn cause devices to function to relieve the trouble. With the ever-increasing size of individual power plants and extending of power systems, relays and protective systems have taken on a greater importance and many new ones have been devised. In this book an attempt has been made to make available all information on the subject, including a description of the various makes of relays and protective systems.

The work has been prepared by the Relay Subcommittee, Electric Apparatus Committee, National Electric Light Association, with the co-operation of the Relay Subcommittee, Protective Device Committee, American Institute of Electrical Engineers, and is divided into general information; detailed description of principal types of relays; circuit-breaker trip mechanism and connections; protection of direct-current systems; protection of alternating-current systems, current and potential transformers; testing, setting, calibrating, maintenance and records; system-fault calculations, and bibliography of the subject.

In the section on relay description a 13-page table is given of relay applications which give the protection to be provided, the type and characteristics of the relays to be used and other information for the application. The section describing the different types of relays is comprehensive and comprises over 400 pages and about the same number of illustrations. From the viewpoint of the operator the 100-page chapter on testing and maintenance is of particular interest, as the latest and best practices are given. The book closes with a bibliography of the articles on relays that have been published in thirty different technical journals from 1908 to 1924. This handbook contains a wealth of information on the subjects it is intended to cover, presented in an easily understood form and should have a wide patronage among those in any way interested in relays and power-protective systems.

Die Kolbendampfmaschinen (Reciprocating Steam Engines). Fifth edition, 1925, enlarged and revised. By A. Pohlhausen. Published by Otto Spamer Täubchenweg, Leipzig, Germany. Size 7x11 in.; 526 pages; 23 insert plates (engine details); 440 text illustrations. Price, 25 gold marks in paper cover and 28 gold marks in cloth.

This large volume, treating the subject of steam-engine design in the exhaustive manner characteristic of German technical writers, should be a valuable addition to the library of the designer who can read the German language.

A Condensed Collection of Thermodynamic Formulas. By P. W. Bridgeman, Professor of Physics in Harvard University. The Harvard University Press, Cambridge, Mass., 1925; 6¼x9½ in.; 34 pages, cloth.

This little volume is a valuable contribution to the literature of thermodynamic theory, and should prove very useful indeed to those whose interests lie in that direction. The ordinary reader is warned that the formulas given by this book are all in terms of derivatives of the first and second order, and that nothing in the book even remotely resembles the familiar algebraic formulas for the calculation of numerical results. The kind of thing that this book enables one to establish very quickly may be illustrated by the differential equation which states that the rate of change of entropy with pressure at constant temperature is equal to the negative of the volumetric coefficient of expansion with temperature at constant pressure. Relations of this sort are invaluable in establishing sound scientific data, such as appears in the ordinary steam table. The investigator in the field of heat phenomena must have theoretical information available. The engineer concerned with the application of processes to the operation of machines and plants, on the other hand, will ordinarily find no pressing demand for information of this nature.

Water Resources of Tennessee. There has recently been made available by the State of Tennessee, Department of Education, Division of Geology, Bulletin 34, on the Water Resources of Tennessee. Copies of this bulletin can be obtained by writing to O. Powell, secretary, Division of Geology, Nashville, Tenn. This report is a compilation, comprising 909 pages, with fifteen maps and profile drawing of existing data pertaining to the surface waters of Tennessee and their utilization, by Warren R. King. The compilation was made in co-operation with the United States Geological Survey and the United States Engineer Department.

The purpose of the report is to place in the hands of engineers, development companies and the public generally all available basic data relating to the streams of Tennessee. No attempt has been made to elaborate upon the resources and possibilities or to form any specific conclusions as to the best method of bringing about their utilization. The data will assist engineers and others to arrive at a proper solution of the many problems involved in hydraulic enterprises and to draw their own conclusions intelligently.

A large part of the data in this report has been published in one form or another, primarily in various government reports, distributed over a period of 50 years. During the last five years there has been accumulated a considerable amount of new data and this appears for the first time. The report is in a sense a catalog of the water resources of the state and although the inventory is not complete, it represents the present knowledge of the flow and character of the streams and forms a basis of operation for future studies of this kind.

Analyzing Foreign Machinery Markets Statistically is the title of a booklet issued by the Bureau of Foreign and Domestic Commerce, Industrial Machinery Division, which can be obtained upon request. It includes a glossary of terms and gives the class number of the different commodities. Those wishing to get statistical information in regard to exports of various types of machines will be able to get the statement number covering the particular item from this booklet.

Fundamentals in the Conditioning of Boiler Waters, R. W. Hall, physical chemist, Pittsburgh Experiment Station, U. S. Bureau of Mines, has been reprinted by the Engineers' Society of Western Pennsylvania, William Penn Hotel, Pittsburgh, Pa., and may be obtained for 50 cents the copy. This article has also been reprinted by the Hagen Corporation, 502 Bowman Bldg., Pittsburgh, Pa., and may be obtained free by writing for it.

A Report of Experiments to Determine the Relative Power Transmitting Capacity of Belts on Vertical, Angular and Horizontal Drives, by R. F. Jones, research engineer in the Leather Belting Exchange Foundation, Cornell University, Ithaca, N. Y. Published by the Leather Belting Exchange, Philadelphia, Pa., 1926.

News in the Field of Power

International Electrotechnical Commission Begins Its Sessions

Large Delegation of Canadian and American Engineers Meet Incoming Foreign Committeemen

THE official welcome to America of the delegates of the International Electrotechnical Commission on the evening of Tuesday, April 13, was the purpose of a meeting filling the auditorium of the United Engineering Societies Building. In addition to over one hundred official delegates and ladies from sixteen foreign countries, there were many representatives of the engineering profession in this country whose activities have been directed to the work of the commission.

Dr. Clayton H. Sharp, president of the United States National Committee, introduced the chairman of the evening, John W. Lieb, chairman of the Reception Committee, who read a telegram of greeting from Thomas A. Edison, honorary chairman of the Committee, who was unable to be present.

The opening address was a brief word of greeting and encouragement from the Hon. Herbert Hoover, Secretary of Commerce. It seemed peculiarly fitting to the opening of this electrical congress that Mr. Hoover, unable to be present in person, should address the meeting from his home in Washington by telephone and loud-speaker. He expressed his deep interest in the work of the organization both in his official capacity and as an engineer, the subjects to be considered being of the first importance to the continued progress of science and industry. He pointed out that every nation has contributed to electrical development, which knows no national boundaries, and that for the adequate prosecution of this great task the world must have common terms and common standards. These are important in cheapening the cost of construction. Standards eliminate waste in thought and material and stimulate wider thought, extensive use and active progress. The ultimate purpose is not merely to establish terms and specifications, but to generate cheaper power, to lighten the burdens of labor, and to increase its productivity. The organized search for truth must go on. That is the work of the International Electrotechnical Commission.

The next speaker, Professor Elihu Thomson, Past President of the I. E. C. and of the A. I. E. E., was greeted with hearty applause. He outlined the history of the early electrical congresses which established the c. g. s. system of units now universally used in scientific and practical electrical work, and recounted how the I. E. C. sprang from that early beginning, as a recognition that no nation can live by itself, that all must enter into agreement with others to think and work in common terms.

Dr. Howard T. Barnes, professor of Physics at McGill University, president of the Canadian National Committee, expressed the pleasure of himself and his associates in joining the United States National Committee as hosts to the foreign delegates.

C. Le Maistre, general secretary of the I. E. C. and secretary of the B. E. S. A., read a cablegram from Lord Balfour, of Great Britain, expressing confidence that the work of the commission will fulfill all expectations leading to the establishment of co-operation so essential to progress, especially in the scientific field.

Col. R. E. Crompton, honorary secretary of the I. E. C., the dean of the electrical industry in Great Britain, was received enthusiastically, and spoke in a reminiscent way of the early days of the Commission's activity in which he took a leading part. He said that the Commission could never have accomplished anything by force, but that the adoption of methods of persuasion to secure the consent of those who would use the pronouncements of the organization has made possible substantial progress. Electrical progress has been great and promises to be greater. Colonel Crompton looks forward eagerly to the extension of the comforts and conveniences of electricity to the humblest resident of city or country.

Responses were made for various European countries. M. Genissieu, of France, spoke at length in French, and Mr. Enstrom, of Sweden, emphasized the moral aspect of the movement as a means for bringing peoples closer together in mutual understanding. Efforts to do this along technical lines are most successful, because the motive of engineering activities is service, not money.

Prof. V. List, of Czechoslovakia, spoke on behalf of the nations of Eastern Europe, and Prof. Dr. Strecker, of Heidelberg University, president of the German National Committee, spoke for Central Europe. This was the first official appearance of German delegates after their re-entrance into the commission following the war, and Dr. Strecker was heartily applauded. He said that as engineers build bridges and boats and railroads and telegraph lines to unite separate peoples, so also should they and all scientific workers labor to promote the peace of the world, organizing their work on geographical, not political, lines.

Pres. Guido Semenza, representing Italy, responded officially for the Commission, rejoicing in the fact that the meetings are held in various countries, promoting acquaintance and mutual understanding among the delegates. He outlined the history of the body, beginning in 1906 in an attempt to unify technical terminology. Even in this there was serious difficulty. Standardization means adopting one thing, and hence entails abandoning all others. National usages are deep-seated, and compromise is difficult. Such resistance is a matter of prejudice—none is right and none is wrong—but nevertheless presents real difficulties for the organization. President Semenza said that visionary ideals did not rule the Commission, but that each nation entered to secure profit for itself. In benefitting themselves, member countries develop the greatest good for all. Thus far the results accomplished are not pretentious—the war was a serious interruption, and resumption has been almost as difficult as the initial work of twenty years ago. Now, however, with a proper spirit and a complete organization, advance will be more rapid. The I. E. C. has opened the way, and organizations in other fields should follow.

Technical sessions of the commission are scheduled daily until Friday, April

Four of the Visiting Committeemen—Left to right: Dr. Carl Strecker, Dr. G. Semenza, Sir R. Glazebrook, Col. R. E. Crompton

23, when the foreign delegates leave for a ten-day tour of the eastern United States.

Revised List of Delegates

Austria—P. Bretschneider, vice-president, Austrian Standards Committee.

Belgium — Franz Dupont, chief engineer, Ateliers de Construction, Electrique, Charleroi, and Mrs. Dupont; E. Uytborck, secretary, Belgian Electrotechnical Committee; L. Colson, general director, Electrical Section, Belgian State Railways; C. Baron Forgeur, director at head office, Ministry of Industry; M. Danly, Société financier de Transports et d' Entreprises Industrielles; Victor Lagasse de Locht, Société Générale des Chemins de fer Economiques.

Canada—Dr. H. T. Barnes, president, Canadian National Committee, I.E.C., Professor of Physics, McGill University; James Kynoch, chief engineer, Canadian General Electric Co., Toronto; John Murphy, electrical engineer, Department of Railways and Canals, Ottawa.

Chili—Ing. Domingo, Santa Maria.

Czechoslovakia—Prof. V. List, chairman, Czechoslovakian Electrotechnical Commission; F. Pergler, Czechoslovakian Standards Committee; Dr. B. Rosenbaum, secretary, Czechoslovakian Standards Committee.

France—G. J. Darrieus, Cie Electromécanique; J. J. Frick, Société Alsacienne de Construction Mécaniques; E. Genissieu, Ing. en chef des Forces Hydraulics et de distribution d'energie au Ministère des Travaux Publics; P. Girault, Cie Fr. Thomson-Houston, delegate, Union des Syndicats de l'Electricité; E. Roth, Société Alsacienne de Construction Mécaniques, delegate, Fédération des Syndicats de la Construction Mécanique, Electrique and Metallique.

Germany—Dr. L. Fleischmann, Allegemeine Elektricitas Gesellschaft; Herr Hochtl, chief government architect; Dr. O. Kienzle, German Standards Committee; Prof. Dr. M. Kloss, professor at Charlottenberg; Prof. A. Maier, German Standards Committee; Dr. Moldenhauer, Markisches Elektrizitas-Werk; Prof. Dr. Rudenberg, Siemens-Schuckerlwerke; P. Schirp, secretary, German Electrotechnical Committee and V.D.E.; Herr Schlothauer, Consellor of Commerce; Herr Schuchardt, Concellor of Commerce; Dr. Richard Stern, Rhenania-Ossac Mineralowerke and Mrs. Stern; Herr Stotz; Prof. Dr. C. Strecker, president, German Electrotechnical committee, professor at Heidelberg; Director Strehlow; K. W. Wagner and Mrs. Wagner.

Great Britain—L. B. Atkinson, director, Cable Makers' Asso.; S. C. Bartholonew, General Post Office; E. G. Batt, General Electric Co.; W. S. Burge, English Electric Co.; Col. R. E. Compton, Hon. Secretary, International Electrotechnical Commission, British Engineering Standards Committee; Miss Culme-Seymour; Mrs. Daman; Sir Archibald Denny, vice-president British delegation, chairman, British Engineering Standards Association; Capt. P. Dunsheath, W. T. Henley's Telegraph Works; Lt.-Col. K. Edgcumbe, Everett, Edgecumbe & Co.; A. R. Everest, British Thomson-Houston Co. and Mrs. Everest; Sir Richard Glazebrook, president, British National Committee, British Engineering Standards Association; P. Good, secretary, British delegation, British Engineering Standards Association, and Mrs. Good; W. Lee, Silvertown Lubricants, Ltd.; C. Le Maistre, general secretary, International Electrotechnical Commission, British Engineering Standards Association; W. S. Marshall, Shell-Mex, Ltd.; S. W. Melsom, Callender's Cable & Construction Co.; Dr. A. C. Michie, consulting engineer, R. B. Mitchell, municipal electrical engineer, Glasgow; A. P. Mossay, Messrs. Mossay & Co.; J. S. Peck, Metropolitan Vickers, Electrical Co., and Mrs. Peck; C. Rodgers, secretary, British Electrical & Allied Manufacturers' Association; T. Roles, municipal electrical engineer, Bradford; R. F. Rowell, secretary, Institution of Electrical Engineers and Mrs. Rowell; F. Wallis, English Electric Co.

Holland—Prof. C. Feldman, president, Dutch Electrotechnical Committee; T. Rosskopf, director, Transformer Works, Nijmegen; W. G. Tromp, secretary, Dutch Electrotechnical Committee, secretary, Dutch Standards Committee and Mrs. and Miss Trump; Prof. C. Van der Bilt, professor, Technical University, Delft; G. J. Van de Well, extraordinary member, Patent Service.

Italy — G. Bianchi, Italiana State Railways; Carlo Clerici, Soc. Edison per la Fabbricazione delle Lampade, Ing. Clerici; Piero Ferrerio, Societá Générales Italiana Edison di Electricci Italian Standards Committee; Orieste Jacobini, Italian State Railways; L. Lombardi, president, Italian Electrotechnical and Standards Committees; G. Minucciani, Italian State Railways; Prof. E. Morelli, School of Engineering, Turin; Ing. Luciano Pello; Natale Ratti, Riva Company of Milan, Italian Standards Committee; Guido Semenza, president, International Electrotechnical Commission; E. Theseider-Dupre, Italian State Railways; Ing. R. Vallauri, professor of electric traction, Milan Technical School; E. Virgilli, Italian State Railways.

Russia—Prof. M. Chatelain, chairman, Russian Electrotechnical Council; Lapiroff-Scoblo, Russian Standards Committee; Papernoff, secretary, Russian Standards Committee; Zischievsky, Russian Standards Committee.

Sweden—A. F. Enstrom, chairman, Swedish Standards Committee, and Mrs. Enstrom; E. C. Ericson, secretary, Swedish Electrotechnical Committee; Amos Kruse, secretary Swedish Standards Committee; S. Norberg, vice-president, Swedish Electrotechnical Committee, Swedish General Electric Co.; Nordstrom, Swedish Standards Committee; H. Nystrom, secretary, Electric Manufacturers' Association; S. E. Osterberg, asst. secretary, Swedish Standards Committee; G. Thielers, Swedish General Electric Co.

Japan—M. Y. Inomata, Japanese Engineering Standards Committee; K. Ishikawa, engineer, Shibaura Electric Works & Co., Dr. Shoji Konishi, chief engineer, Japanese Engineering Standards Committee; H. Mori, engineer, Bureau of Electricity, Ministry of Communications; T. Tada, engineer, Mitsui Bussan & Co.; Y. Yanagisawa, engineer, of Mitsubishi Denki & Co.; S. Yoshiwara.

Poland—C. Daenowski, secretary, Polish Electrotechnical Committee; Roginski, secretary, Polish Standards Committee; Dr. Z. W. Wiecke, chairman, Polish Standards Committee.

Switzerland — Charles Burlet, electrical engineer, Swiss Federal Railways; Prof. C. Honig, chairman, Swiss Standards Committee; A. Huber-Ruf, engineer, Brown Boveri Co.; E. Huber-Stockar, president, Swiss Electrotechnical Committee; Dr. Hans Max Schindler, Ateliers de Construction Oerlikon; Antoine Schrafl; Swiss Federal Railways; Paul Thut, Bernese Power Works.

Second Annual Chicago Power Show

Announcement has just been made that the second annual power show for Chicago and the Midwest territory will be held in the Coliseum Building from Feb. 15 to 19, inclusive, 1927. The big success of the first show held last January augurs well for the success of the second show. This is being planned on a larger and broader scale and is meeting with gratifying response from exhibitors. The change in location to the Coliseum Building was necessary, as the Furniture Mart Building is no longer available for exposition purposes. Incidentally, the Coliseum offers larger floor space, the measurements being 500x160 ft., which is practically devoid of pillars. Convenient transportation to the building is available, and on the second floor of the south hall there is a conference room having a seating capacity of 1,200. This will be available for engineering meetings of importance covering various phases of the power industry, and no doubt will be used for the Power Conference which will be held during the same week at Chicago.

New England Textile Exposition and Power Show

Two hundred and seventy-five companies were represented at the Bi-Annual "International Textile Exposition and National Power Show" held during the week of April 12-17 in the Mechanics Building, Boston, Mass.

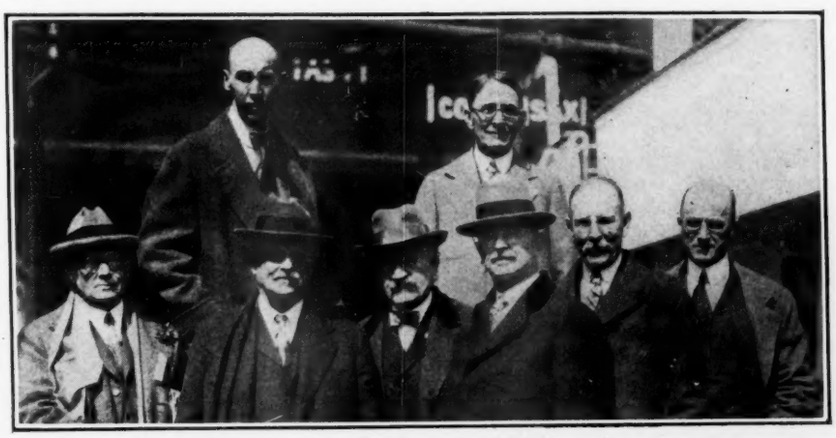
For the most part manufacturers displayed their equipment in actual operation, every step having been taken to show the visitor fabric in the making from start to finish, as well as the many different ways in which the engineer in charge of power, generation and transmission could save expense or improve results.

Shawinigan Co. and Aluminum Corp. Buy Duke-Price Interests

It has been reported from Montreal that the Shawinigan Water and Power Co. group and the Aluminum Corp. of America interests have purchased from the Duke and Price estates respectively their interests in the Duke-Price Power Co. It is understood that the purchase was on a sixty-forty basis—the Aluminum company sixty and the Shawinigan company forty.

In this connection it is recalled that the Duke-Price Power Co. at Isle Maligne on the Saguenay River installed and brought into operation 400,000 hp. last year, comprising eight 50,000-hp. units. Two additional units are being installed and are expected to be completed shortly.

The Aluminum Corporation of America at Chute-a-Caron has plans for the ultimate development of 1,000,000 hp. The initial installation will consist of three 90,000 hp. units.



A group of the Welcoming Committee—Left to right, rear: Dr. P. G. Agnew, C. E. Skinner; front, Dr. F. R. Low, Prof. Elihu Thomson, Dr. C. O. Mailloux, Dr. C. H. Sharp, Prof. A. E. Kennelly, Prof. C. A. Adams

New Plan for Development of St. Lawrence Presented

On April 9, Col. Hugh L. Cooper, consulting engineer, New York City, made the first public presentation of the plan of the Frontier Corporation for the development of the water power of the International Section of the St. Lawrence River, at a hearing on this project in Albany. As outlined by Colonel Cooper, the plan calls for a dam across the river at Long Sault Rapids, 40 miles east of Ogdensburg, which will raise the level of the river about 83 ft. and back the water up to Lake Ontario. The total cost of the development was placed at $238,000,000 and would produce 2,400,000 hp., one-half of which would be available to New York State. This power will be developed in two plants, one on the New York side of the river and one on the Canadian side with a spillway in between, as shown in the figure. Each power house is to be 1,900 ft. long and contain twenty-four 50,000-hp. units.

Cost of Project To Be Provided by Private Capital

All the cost of the project is to be provided for by private capital, and it can be completed in 4½ years after permission is granted to go ahead with the work. According to Colonel Cooper, this will be the cheapest water power in the world. This, however, is probably open to question, as there have been large water-power developments made for much less than $100 per hp., the Colonel's figures for the St. Lawrence Development.

Even if permission were granted by New York State to go ahead with the work, it would be necessary to enter into an agreement with Ontario before the development could be started, according to George T. Bishop, president of the Frontier Corp., which is owned by the General Electric Co., Aluminum Company of America and the E. I. du Pont de Nemours Co.

Mr. Bishop was of the opinion that Ontario was not in a position to finance her share of the project, but that private capital was willing to help and expected to have a plan that would bring all financing and construction under one control. At the conclusion of the hearing Senator John Knight suggested that it would be desirable to have Colonel Cooper outline his plan to the members of the State legislature. Although at that time it was tentatively agreed that this should take place on April 20, the plan for this hearing has since been abandoned.

This project, according to its promoters, would in no way interfere with the proposed Lakes-to-Sea-Canal, but would help navigation. The water in the rapids is now so swift that ordinary vessels cannot go up them, and now pass up through a lock. The new plan calls for an additional lock with a lift of 54 ft. to care for navigation during and after construction of the plant.

Engineers Point the Road to Big Executive Jobs

What qualifications must an engineer have before he can aspire to one of the high executive positions, paying salaries from $15,000 to $100,000 per year? This was the question discussed on April 15th by prominent engineer-executives before seven hundred civil, mechanical, mining and electrical engineers assembled in the Engineering Auditorium in New York City. The meeting, held under the auspices of the Metropolitan Sections of the four major engineering societies was addressed by E. M. Herr, president, Westinghouse Electric and Manufacturing Co., H. A. Guess, vice-president, American Smelting and Refining Co., Dr. Frank B. Jewett, vice-president, American Telephone & Telegraph Co. and J. C. Parker, vice-president and chief engineer, Brooklyn Edison Company.

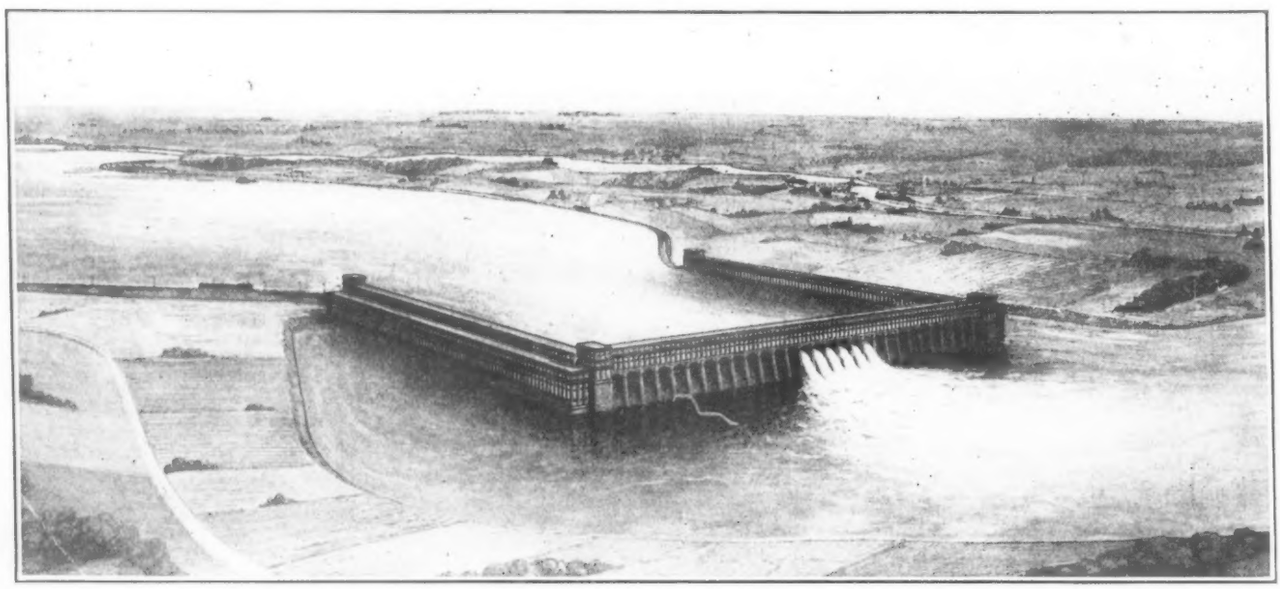
All of the speakers agreed that high executives of the future particularly in engineering industries, would come more and more from the ranks of engineers. There was also general agreement that technical competence alone could never make a great executive unless reinforced by such qualities as capacity for leadership, character, keen and sympathetic knowledge of human nature, knowledge of business and financial fundamentals, as well as other essentials.

In addition to these, E. M. Herr, mentioned decision, initiative, ability to evaluate men and materials and to make economic decisions, and willingness to assume responsibility for one's acts. Like the other speakers he stressed the importance of learning the fundamentals rather than the details of practice in school. He recommended broadening studies as an antidote for too much specialization. H. A. Guess felt that—contrary to the prevailing impression—engineering had its full quota of high executives. He emphasized the value of training in speaking and writing.

Dr. Jewett Stresses Necessity of Fundamentals

As head of a great research laboratory, Dr. Jewett naturally stressed the value of solid grounding in the fundamentals. The engineering executive he said, needed character, personality, imagination, initiative, fairness. Dr. Jewett felt that in the future the executive without engineering training would be at a great disadvantage. Technical skill would never hold a man back unless he allowed it to kill his interest in other matters of equal importance.

The human virtues were placed first in the equipment of the executive by J. C. Parker. Men, he said, got just about what they deserved on the average. Executive positions would come to engineers as fast as they reinforced their knowledge of technique with other qualifications such as the broad scientific point of view, ability to generalize, and above all knowledge of men and fairness in dealing with them.



Perspective drawing of the proposed development on the St. Lawrence River, showing the two power houses with the spillway in between

White River May Have 200,000 Hp. Project

Final inspection of the hydro-electric site at Table Rock, Mo., in the White River, where the Empire District Electric Co., of Joplin, is asking a license to install a plant with an ultimate rating of 200,000 hp. at a cost of $30,000,000, was made by federal engineers on April 18.

Result of Questionnaires on Oil Not Available at Present

As chairman of the President's Oil Board, Secretary Work of the Interior Department, in a letter addressed to Charles E. Hughes, counsel for the American Petroleum Institute, stated that it was the conclusion of the Board that it will be inadvisable to make available the material which it has received from the oil industry, in response to the government questionnaires, before submitting its completed report to the President. The American Petroleum Institute had, through Mr. Hughes, recently requested the chairman for this specific material.

New York's Peaceful Arts Museum Making Plans

Preliminary steps toward the foundation in New York City of a Museum of the Peaceful Arts, for which the late Henry R. Towne left a bequest of more than a million dollars, are being taken through visits of American scientists and industrialists to Europe to inspect similar institutions there and gather information helpful to the project. Elmer A. Sperry, electrical engineer and inventor of the gyro-compass, has already departed on such a quest. At a later date, John W. Lieb, vice-president New York Edison Co., will make a similar trip, specializing in the study of light, heat and power exhibits. Other eminent engineers who are booked to help the movement by personal investigation abroad are Ambrose Swasey, who established the Engineering Foundation; President S. W. Stratton of the M. I. of T., Secretary C. W. Rice of the A.S.M.E. who has already sailed for Europe, and Secretary H. Foster Bain of the A.I.M.E.

St. Lawrence-Morrisburg Project Being Held Up

The Ontario government's application for permission to develop power on the St. Lawrence at Morrisburg, was approved by the Canadian Parliament on April 7, but no action will be taken by the federal government in the way of granting the necessary permit until it has received the report of the International Board of Engineers acting in behalf of Canada and the United States and now investigating the question of St. Lawrence developments.

Since early in 1923 the Ontario Government and the Ontario Hydro-Electric Power Commission have been making annual application for permission to go ahead with the work, but the federal government has refused on the ground that the development of power on the St. Lawrence at Morrisburg had an international aspect, the international boundary cutting the river in two. It was held to be desirable that there should be an understanding between the United States and Canada as to the best means of developing the water power on an equitable basis.

Five Muscle Shoals Bids Being Considered by Joint Committee

Muscle Shoals Power Distributing Co. and Muscle Shoals Fertilizer Co. Consist of Many Utility Companies

NINE BIDS for the Muscle Shoals properties of the government were submitted to the Joint Congressional Committee on or before noon April 10. The committee has announced that five of the nine bids are being considered. They are the bids of the following companies and individuals: The Union Carbide Co.; the American Cyanamide Co.; the Muscle Shoals Power Distributing Co., and the Muscle Shoals Fertilizer Co.; Frederick T. Hepburn, and Elon H. Hooker and associates. The other bids which were submitted, but which do not come within the terms of the resolution, are those of F. E. Castleberry, Shreveport, La.; Lloyd H. Smith, of Battle Creek, Mich.; C. E. Graff, of the American Nitrogen Products Co., Seattle, and James F. Levering, Washington, D. C. Bids which may be received prior to the submission of the report to the committee will be filed with Congress with a statement that they were received too late to be analyzed and considered.

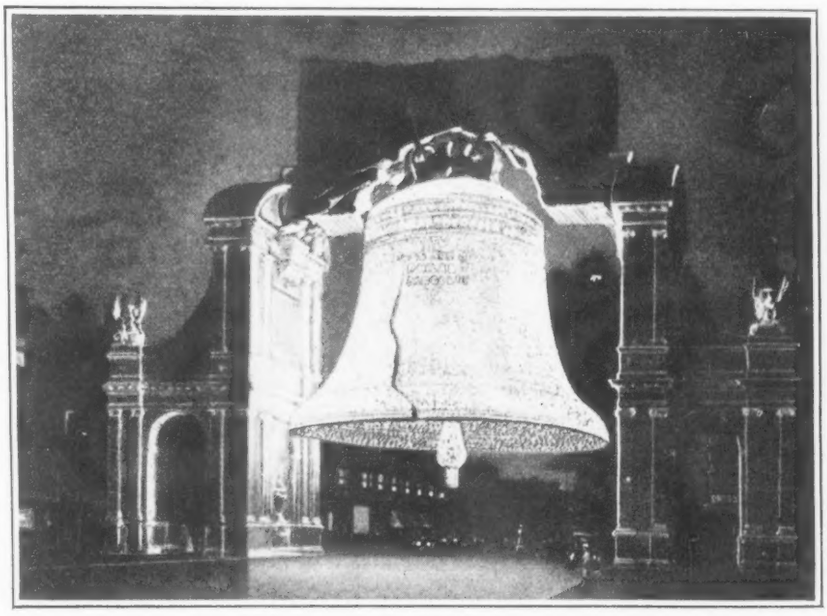
In its statement announcing the names of those who had submitted bids, the committee stated that the offer of the Muscle Shoals Power Distributing Co. and the Muscle Shoals Fertilizer Co. was made in behalf of the following public utility companies: The Tennessee Electric Power Co., Chattanooga; Memphis Power & Light Co., Memphis; Mississippi Power Co., Gulfport, Miss.; Mississippi Power & Light Co., Jackson; Mississippi Delta Power & Light Co., Greenville, Miss.; Alabama Power Co., Birmingham; Gulf Power Co., Pensacola; Kentucky Utilities Co., Louisville; Gulf Electric Co., Mobile; Georgia Railway & Power Co., Atlanta; Louisiana Power & Light Co., Monroe; Arkansas Light & Power Co., Pine Bluff; New Orleans Public Service, Inc., New Orleans.

The bids have been referred to the interdepartmental advisory committee consisting of Dr. F. G. Cottrell, Director of the Fixed Nitrogen Research Laboratory, of the Department of Agriculture; Dr. Elwood Mead, the Commissioner of Reclamation; General Harry Taylor, the Chief of Engineers; and Paul Clapp, an electrical engineer on the staff of the Secretary of Commerce.

Enormous Liberty Bell of Light for Sesqui

Work has started on the construction of the enormous Liberty Bell which, when completed, will be arched over the entrance gates to the Sesquicentennial Exposition, on South Broad Street, Philadelphia.

The bell, which is being constructed by the Westinghouse Lamp Co., was designed by D. W. Atwater. It will contain 26,000 incandescent lamps and its lighting will require 500 kilowatts. It will be visible from either end of the thoroughfare, a distance of two and one-half miles. Its height has been estimated at 75 ft., about the height of an ordinary six-story building.



"Liberty Bell of Light" being erected in Philadelphia for the Sesqui celebration

Jadwin Appointed as Chief of Engineers, U. S. A.

Promotion of Brig. Gen. Edgar Jadwin, now assistant chief of engineers, to be chief of engineers, with the rank of major general, effective June 27, when Maj. Gen. Harry Taylor retires, was announced on April 7 from the White House.

General Jadwin is well known as the original surveyor of the intracoastal canal between New Orleans and Corpus Christi, and other important work in the South, including the Panama Canal. In his capacity as chairman of the Board of Engineers for Rivers and Harbors and as officer in charge of river and harbor matters for the Corps of Engineers, he has become an outstanding authority on river and harbor engineering. He was director of construction of railroads, cantonments, hospitals and dredging operations in France during the World War.

River Power Survey Program Will Cost $7,322,400

It will cost $7,322,400 to make general examinations of all streams where power development appears feasible. A report supporting that conclusion just has been sent to Congress by the Chief of Engineers and the Executive Secretary of the Federal Power Commission.

The river and harbor act of 1925 made provision for this estimate of cost as an outgrowth of agitation for legislation proposing to devote license fees collected under the water power act to general surveys, sufficiently accurate to allow of comprehensive plans of water utilization.

It is pointed out in the report, however, that it is not necessary or desirable to provide at once for a comprehensive program of surveys, but the importance of the work and the length of time required to complete it are such that it should be inaugurated as soon as practicable, the report recommends.

Data of the character proposed, it is stated, would be of particular value in reaching correct decisions as to the best plan for the comprehensive development of the power resources of streams. The report suggests that attention be given first to streams on which there is a possibility of the federal government's undertaking, either alone or in connection with private interests, construction work for the improvement of the stream.

New Type Shallow-Water Boat Invented by Carl Baer

A little shallow-water tank, a boat that differs from all other craft ever in the water, named "Sunco," which bears the same relation to the Mississippi River in the matter of locomotion that the war tanks did to the high road, is now in St. Louis, Mo., at the foot of Market St., according to the *Christian Science Monitor*.

Instead of having wheels and propellers, the "Sunco" moves by the caterpillar process. Its present power is gasoline compression, which is to be supplanted by a Diesel engine. It moves in either direction at the same speed, the prow and stern being indicated only by the direction in which it is moving. The purpose of the craft is to handle barge units in shallow water.

Rivermen from St. Louis and Kansas City who are studying the strange craft are inclined to believe the device has great power and complete practicability, but they are reserving positive opinions while taking a great interest in its construction and "handling."

On a recent test, an empty barge was pushed and pulled in rapidly changing directions. At one point a huge wave from a passing steamboat swamped the barge. It took water rapidly and sank. The "Sunco" gave it a line, reversed the engine and in three minutes had hauled the barge up at an angle, emptied enough of its water load to right it and in another 10 minutes had tied the barge to its wharf.

Ten years from now the "Sunco" may be as amusing as Robert Fulton's first boat, the "Clermont," and the first chain-drive motor. Resting in the river, it looks like a greenhouse afloat. The entire shelter deck is inclosed in glass, revealing within a curved hump that fills most of the decks. This is the housing for the caterpillar. Below this point the hull has the appearance of the body of any other river boat, with the difference that the two ends have the same shape.

The caterpillar runs under the hull at the point where the keel would be and the cups, which are about a foot apart, are not solid. Perforations let a portion of the resisting water through. The inventer in Carl Baer, long attached to the St. Louis Chamber of Commerce. Mr. Baer does not claim perfection for his plan, but he says that experiments have proved that shallow water transportation is practicable.

John Edson Sweet Memorial To Be a Professorship

As a memorial to John Edson Sweet, first head of the College of Engineering at Cornell University, inventor of the straight-line engine and one of the founders of the A.S.M.E., friends of Cornell University are raising a fund to endow a professorship at Cornell to be known as the Sweet Memorial Professorship.

The endowment plan happens to coincide to some extent with the Sesquicentennial celebration in Philadelphia, in the fact that the straight-line engine invented by Professor Sweet was used at the 1876 Centennial to drive the first dynamo ever made in the United States. This dynamo was constructed at Cornell and is still in use in a Cornell laboratory.

Professor Sweet died in 1916, and it was at that time suggested that a memorial might take the form of a new mechanical laboratory. Since then the plan has been modified, as it was felt that the professorship becomes an imperishable part of the institution, while stone and mortar fall to decay.

More than half of the fund has already been subscribed by about one hundred men, and it is thought that other persons interested in engineering education will complete the fund within a short time.

Personal Mention

A. D. Little of the A. D. Little & Co., Cambridge, Mass., gave a public address on the subject of "The Romance of Carbon," in connection with the seventy-first meeting of the American Chemical Society, which was held in Tulsa, Okla., April 5-9.

Harold R. Keller, formerly with the Tide Water Oil Sales Corp., Boston, Mass., as lubrication engineer and industrial sales supervisor for New England, has joined the engineering division of Stone & Webster, Inc., at its Boston office.

J. Maldonado, formerly electrical engineer for the Brooklyn Edison Co., has signed a contract with the Worthington Pump & Machinery Corp., and will assume the managership of its Barcelona offices, "Compania de Bombas Worthington," Plaza Universidad, 2, Barcelona, Spain.

Obituary

Professor Aime Witz, an authority on internal-combustion engines and heat utilization, died on Jan. 25 at Lille, France, in his seventy-seventh year. Professor Witz had taken a prominent part in the electrical development of France.

Francis Hird, managing director of Siemens Bros. & Co., Ltd., London, Eng., and of subsidiary companies, died recently at the age of fifty-nine. He was born of British parents in Paris in 1868, going to England in early childhood and getting his education at the Bradford grammar school, from which he secured a National Sciences Exhibition at Trinity College, Cambridge, and studied under Prof. J. J. Thomson at the Cavendish Laboratory. He obtained his degree of B.A. in 1887. In 1889 he joined the staff of Siemens Brothers & Co., Ltd., and became in turn chief dynamo designer, works manager of the dynamo works, general manager in 1922, and managing director in April, 1925.

Edwin F. Deming, mechanical engineer with the Pickering Governor Co., Portland, Conn., died of pneumonia at the Middlesex Hospital, Middletown, Conn., on March 1. He was born in 1878 in Iowa where he began his education, which he continued in Connecticut. Unable to go to college, he took correspondence courses in both steam and electrical engineering during his free hours. To obtain as much practical experience as possible, he spent four years in various power plants, going to work for the Pickering Governor Co. in 1902. His ability was soon recognized and he was transferred from the power plant to the engineering department, where he became a successful designer of steam specialties. Later he took charge of the testing of the apparatus of the company for the control of steam and gas engines, and he also traveled extensively studying at first hand the needs of the industry. He was a member of the A.S.M.E.

Society Affairs

The Lehigh Valley Section of the A.I.E.E. will hold its April 23 meeting at Hazelton. "Oil Switches," by George A. Burnham, Condit Electric Co., and "Horsepower," by John J. Johnson, attorney for the Westinghouse Electric & Manufacturing Co., are to be the papers given at the meeting.

The American Society of Heating and Ventilating Engineers, through its national council, has created a department of public relations and has announced the appointment of P. E. Fansler secretary. Mr. Fansler is an associate editor of *The Heating and Ventilating Magazine.*

Business Notes

The Reading Iron Co., Reading, Pa., announces that Charles E. Koch has joined its sales force in the Reading district.

The Bayer Company of St. Louis, Mo., manufacturer of soot blowers, has appointed as representative in the Chicago territory, E. H. Bull, 25 W. Jackson Blvd., Chicago.

The Sanderson-Cyclone Drill Co., Orrville, Ohio, purchased in its entirety the motor division of the Wellman-Seaver-Morgan Co. of Cleveland but operated at Akron, Ohio.

John M. Rittlemeyer, formerly associated with the Westinghouse Electric & Manufacturing Co., has recently established himself as an independent manufacturer's agent in the handling of power plant equipment. His office is at 332 Healy Bldg., Atlanta, Ga.

The Ingersoll-Rand Co., 11 Broadway, New York City, announces that Harlan A. Pratt, formerly with the Westinghouse Electric & Mfg. Co. and the Atlantic Elevator Co., has been appointed manager of the oil and gas engine department.

The Sarco Company, Inc., has removed its New York City quarters from the Woolworth Bldg., to 83 Madison Ave., where the offices and warerooms will be more commodious and permit of carrying a complete stock of valves, traps, temperature regulators and strainers.

Trade Catalogs

Grinding Wheels—The Norton Co., Worcester, Mass. A well arranged catalog has recently been issued by this firm covering the grinding wheels manufactured by them.

Coal Pulverizer—The Strong-Scott Mfg. Co., Minneapolis, Minn. A 48-page catalog descriptive of the "Unipulvo" mill and complete unit system for burning pulverized coal. The application to different types of boiler is shown and tabulated data presented showing efficiencies for varying operating conditions.

Coming Conventions

American Boiler Manufacturers Association. D. W. Glanzer, 840 Rockefeller Bldg., Cleveland, Ohio. Annual convention at Homestead, Hot Springs, Va., June 1-2.

American Institute of Electrical Engineers. F. L. Hutchinson, 29 West 39th St., New York City. Regional meetings: Madison, Wis., May 6-7, and at Niagara Falls, May 26-28. Annual convention at White Sulphur Springs, W. Va., June 21-25.

American Order of Steam Engineers. W. S. Wetzler, 758 N. 44th St., Philadelphia, Pa. Annual convention at Moose Hall, Philadelphia, June 7-11.

American Refractories Institute. D. A. Texter, 2202 Oliver Bldg., Pittsburgh, Pa. Annual meeting at Bellevue-Stratford Hotel, Philadelphia, Pa. May 12.

American Society for Testing Materials. C. L. Warwick, 1315 Spruce St., Philadelphia, Pa. Convention at Haddon Hall, Atlantic City, N. J., June 21-25.

The American Society of Heating and Ventilating Engineers. A. V. Hutchinson, 29 West 39th St., New York City. Annual convention at Lexington, Ky., May 26-28.

American Society of Mechanical Engineers. Calvin W. Rice, 29 West 39th St., New York City. Regional meeting at Providence, R. I., May 3-6. Spring convention at San Francisco, Calif., June 28-30.

American Water Works Association. W. M. Niesley, Assistant to Sec., 170 Broadway, New York City. Annual convention at Hotel Statler, Buffalo, N. Y., June 7-12.

Association of Iron & Steel Electrical Engineers. John F. Kelly, 1007 Empire Bldg., Pittsburgh, Pa. Exposition and convention at Hotel Sherman, Chicago, Ill., June 7-10.

Master Boiler Makers Association. Harry D. Vought, 26 Cortlandt St., New York City. Annual convention at the Statler Hotel, Buffalo, N. Y., May 25-26.

National Association of Stationary Engineers. F. W. Raven, 417 South Dearborn St., Chicago, Ill. Convention at Atlantic City, begins Sept. 14. Erroneously announced as Sept. 6-11. Annual conventions and exhibitions of state association are scheduled as follows: **Indiana State Association,** F. L. Clifford, 653 South Union St., Kokomo, Ind., Convention at Lafayette, Ind., May 10-15; **Kansas State Association.** H. S. Dukes, School for the Blind, Kansas City, Mo. Convention at Abilene, Kans., May 19-21; **Illinois State Association.** O. Jacobsen, 837, Lakeside, Place, Chicago. Convention at Decatur, Ill., June 2-4; **New England States Association.** Freeman L. Tyler, 32 Briggs St., Taunton, Mass. Convention at New Bedford, Mass., June 16-19; **Ohio State Association.** T. S. Garrett, 2622 E. Second St., Dayton, Ohio, Convention at Newark, Ohio, June 17-19; **Connecticut State Association,** George F. Klopfer, 30 East Pearl St., New Haven, Conn., Convention at Norwich, Conn., June 25-26; **Wisconsin State Association,** R. L. Scott, Eau Claire, Wis. Convention at Milwaukee, Aug. 3-6; **Minnesota State Association,** C. A. Nelson, 800 22nd Ave., N. E. Minneapolis, Minn. Convention at Rochester, Minn., Aug. 4-6; **New Jersey State Association,** S. G. Dalrymple, 111 Hutton St., Jersey City, Convention at Atlantic City, Sept. 12; **Pennsylvania State Association,** Frank J. McCarron, 3647 North 11th St., Philadelphia, Convention at Philadelphia, Sept. 12-13.

National Board of Boiler and Pressure Vessel Inspectors. C. O. Myers, 14 Commercial National Bank Bldg., Columbus, Ohio. National Board meeting at Chicago, Ill., May 17-18.

National District Heating Association. D. L. Gaskill, Greenville, Ohio. Convention at Niagara Hotel, Niagara Falls, June 1-4.

National Electric Light Association. A. Jackson Marshall, 29 West 39th St., New York City. Forty-ninth convention and manufacturers' exhibition, Atlantic City, May 17-21.

Pyrometers, Thermo-Electric — The Brown Instrument Co., Wayne and Windrim Aves., Philadelphia, Pa. Instructions for the installation and care of these pyrometers are described in an 80-page, well illustrated, catalog, which is indexed for ready reference.

Air Compressors and Pumps—The Pennsylvania Pump & Compressor Co., Easton, Pa., Bulletin No. 127, which is a part of the loose-leaf catalog of this company, covers the direct-connected, synchronous, motor-driven air compressors made by the firm. Bulletin No. 207 describes the multi-stage centrifugal pumps, class OMS, single suction, opposed impeller type. Both bulletins are well illustrated, having cross-sections of the machines as well as photos of installations.

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run except Pittsburgh gas slack:

Bituminous Net Tons	Market Quoting	April 5 1926
Pool 1	New York	$2.50@$2.85
Smokeless	Boston	1.52
Clearfield	Boston	1.75@ 2.00
Somerset	Boston	1.80@ 2.10
Kanawha	Columbus	1.40@ 1.70
Hocking	Columbus	1.40@ 1.70
Pittsburgh	Pittsburgh	1.90@ 2.00
Pittsburgh gas slack	Pittsburgh	1.50@ 1.60
Franklin, Ill.	Chicago	2.35@ 2.50
Central, Ill.	Chicago	2.00@ 2.10
Ind. 4th Vein	Chicago	2.10@ 2.25
West Ky.	Louisville	1.15@ 1.35
S. E. Ky.	Louisville	1.50@ 1.60
Big Seam	Birmingham	1.75@ 2.25
Anthracite Gross Tons		
Buckwheat No. 1.	New York	2.00@ 3.50
Buckwheat No. 1.	Philadelphia	2.50@ 3.00
Birdseye	New York	1.60@ 2.00

FUEL OIL

New York—Apr. 15, light oil, tank-car lots; 28@34 deg. Baumé, 5½c. per gal.; 36@40 deg., 6c. per gal., f.o.b. Bayonne, N. J.

St. Louis—Apr. 7, tank-car lots, f.o.b St. Louis; 24@36 deg., $2.15 per bbl.; 26@28 deg., $2.20 per bbl.; 28@30 deg., $2.25 per bbl.; 30@32 deg., $2.30 per bbl.; 32@36 deg., gas oil, 6c. per gal.; 38@40 deg., 6.6c. per gal.

Pittsburgh—Apr. 6, f.o.b. local refinery; 30@34 deg., fuel oil, 6c. per gal.; 36@40 deg., fuel oil, 6¼c. per gal.

Dallas—Apr. 12, f.o.b. local refinery 26@30 deg., $1.58 per bbl.

Philadelphia—Apr. 14, 27@30 deg., $2.31@$2.37 per bbl.; 18@22 deg., $1.93@$1.99; 13@19 deg., $1.74@$1.80 per bbl.

Cincinnati—Apr. 13, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 6½c. per gal.; 26@30 deg., 6¾c. per gal.; 30@32 deg., 7c. per gal.

Chicago—Apr. 13, tank-car lots f.o.b. Oklahoma, freight to Chicago, 92c. per bbl.; 24@26 deg., $1.45@$1.50 per bbl.; 26@30deg., $1.55; 30@32 deg., $1.70 @$1.75.

Boston—Apr. 12, tank-car lots, f.o.b.; 12@14 deg. Baumé, 4.65c. per gal.; 28@32 deg., 6c. per gal.

New Plant Construction

Ala., Birmingham — Jefferson Hotel Co., will receive bids until May 1 for the construction of a 19 story hotel at 17th and 2nd Ave. Estimated cost $1,500,000. Warren, Knight & Davis, Empire Bldg., are architects.

Calif., Los Angeles—G. A. Lansburgh, Consolidated Bldg., Archt., will soon receive bids for the construction of a 6 story theatre and office building at Wilcox Ave. and Hollywood Blvd. for Warner Bros. Estimated cost $1,000,000.

Calif., Oakland — O. Kehrlein, Tribune Tower Bldg., plans the construction of a 20 story apartment at Lakeshore Blvd. and Madison St. Estimated cost $1,000,000. Miller & Warnecke, 1104 Franklin St., are architects.

Calif., San Francisco—Anchor Chain Safe Deposit Co. Inc., 11 Steuart St., is having plans prepared for the construction of a 15 story office building at Market and Steuart Sts. Estimated cost $1,000,000. H. H. Winner Co., Sharon Bldg., is architect.

Fla., Miami—Dade County Security Co., 1107 Ave. C, awarded contract for the construction of an office building at North East First Ave. and Second St. to Fred T. Ley & Co., Vail Arcade. Estimated cost $800,000.

Fla., Miami—Terminal Hotel Co., is having plans prepared for the construction of a 12 story hotel. Estimated cost $1,000,000. F. J. DeLongchamps, Gazette Bldg., Reno, Nev., is architect.

Fla., Tarpon Springs—Pinellas County Power Co., St. Petersburg, is merging the local plants and plans the construction of a new power plant here. Estimated cost $500,000.

Ga., Savannah—Georgia Ice Co., 431 Harmon St., plans the construction of a 25 ton refrigeration station.

Ill., Bloomington—Bloomington & Normal Sanitary Dist., 422 Unity Bldg., will receive bids until May 6 for the construction of a sewage treatment plant including pumping station, etc. Taylor & Woltman, 225 Unity Bldg., are engineers.

Ill., Chicago—B. E. Cohen & Associates, 139 North Clarke St., are receiving bids for the construction of a 14 story hotel at Rush and Ontario Sts. Estimated cost $1,500,000. E. J. Meles, 105 West Monroe St., is architect.

Ill., Chicago—Hyland & Corse, 159 East Ontario St., Archts., will receive bids about May 1 for the construction of a 12 story office building including oil burning system for One Hundred Eighty West Washington Building Corp., c/o A. E. Klink, 110 North Dearborn St. Estimated cost $1,000,000.

Ill., Highland—City will soon receive bids for improvement to light plant including installation of one 500 kw. and one 250 kw. generating units, etc. Estimated cost $40,000. W. A. Fuller Co., 1917 Railway Exchange Bldg., St. Louis, Mo., is engineer.

Ind., Indianapolis — Indiana Christian Hospital, Senate and Ohio Sts., had plans prepared for the construction of a 16 story hospital. Estimated cost $1,500,000. F. S. Cannon, 4413 Guilford Ave., is architect.

Ia., Cedar Rapids — Edith Rockefeller McCormick, c/o Krenn & Dato, 936 North Michigan Ave., Chicago, Ill., is having plans prepared for the construction of a 12 story hotel on First Ave. here. Estimated cost $1,350,000. H. B. Beidler, 936 North Michigan Ave., is architect.

Ia., Iowa City—State University, W. H. Gemmill, Secy. State Bd. of Education, will receive bids until May 25 for the construction of a 7 story medical college hospital. Estimated cost $2,000,000. Proudfoot, Rawson & Souers, Hubbell Bldg., Des Moines, are architects and engineers.

La., New Orleans—Sewerage and Water Board, G. G. Earl, Gen. Supt., 522 Carondale St., plans additions and improvements to waterworks and pumping station, also the purchase and installation of larger boilers to replace the present plant boilers. Estimated cost $611,000.

Mass., Boston—New England Deaconess Assn., 10 Deaconess Road, will build a 6 story hospital research building at Deaconess and Pilgrim Roads by day labor. Estimated cost $600,000. E. W. Dearing, 19 Deaconess Road, is architect.

Mass., Boston—South Bay Realty Corp., 350 Madison Ave., New York, N. Y., plans the construction of an 11 story office building at Stuart, Clarendon and Berkley Sts., here. Estimated cost $1,000,000. Architect not selected.

Mass., Boston—E. N. Wyner, 18 Tremont St., awarded contract for the construction of a 15 story hotel on Arlington St. to Chase & Gilbert, 220 Devonshire St. Estimated cost $2,000,000.

Mass., Cambridge (Boston P. O.)—G. Ernest, 1134 Massachusetts Ave., plans the construction of a 10 story hotel and stores building at 18-28 Boylston St. Estimated cost $500,000. Architect not selected.

Mass., Holyoke—Gas & Electric Dept., City Hall, is receiving bids for the construction of a boiler house. Estimated cost $40,000. McClintock & Craig, 458 Bridge St., Springfield, are engineers.

Mass., Lynn—Commission of Ways & Drainage, City Hall, is having plans prepared for the construction of a pumping station. M. Knowles, 507 Westinghouse Bldg., Pittsburgh, Pa., is engineer.

Mass., Pigeon Cove (Rockport P. O.)—Cape Ann Tool Co., plans extensions to boiler house and forge shop. Work will be done by separate contracts under the supervision of J. D. DeWolf, 45 Bromfield St., Boston, Engr.

Mich., Detroit—Dept. of Water Supply, awarded contract for the construction of an interior switch house in pumping station No. 1 to Max Bartholomaei Sons & Co., 1754 East Warren Ave. $16,690.

Miss., Moss Point—The Southern Paper Co., awarded contract for the construction of a paper storage warehouse, additions to power house and turbine foundations to Morton C. Tuttle Co., 862 Park Square Bldg., Boston, Mass.

Mo., Bowling Green—City voted $80,000 bonds for the construction of complete waterworks and distribution system including two deep well pumps, service pumps, storage reservoir, 75,000 gal. tank on tower, etc. McCarthy & Elder, Marion, Ill., are engineers.

Mo., St. Louis—Evangelical Deaconess Home & Hospital, 4125 West Belle Place, is having preliminary plans prepared for the construction of a 4 story hospital at Oakland and Clayton Aves. Estimated cost $500,000. T. P. Barnett Co., Arcade Bldg., is architect.

Mo., St. Louis — Stuyvesant Realty & Building Co., International Life Bldg., plans the construction of a 20 story hotel and theatre building at Lindell St. and Spring Ave. Work will be done by separate contracts under the supervision of P. J. Bradshaw, International Life Bldg., Archt.

Neb., Grand Island—City, H. E. Clifford, Clk., will receive bids until April 27 for improvements to waterworks and power plant including two 700 hp. Connelly water tube boilers, boiler feed pumps, coal handling equipment, etc. Estimated cost $65,000. Pillsbury Engineering Co., 2344 Nicollet Ave., Minneapolis, Minn., is engineer.

N. H., Rochester—Rochester Realty Co., c/o Dow, Harlow & Kimball, 184 Boylston St., Boston, Mass., Archts., is having preliminary plans prepared for the construction of a 3 story apartment, stores and office building including lighting plant at Hanson, Wakefield and Autumn Sts. here.

N. Y., Albany—Equitable Life Assurance Society, 120 Broadway, New York, awarded contract for the construction of a hotel on Broadway, here, to E. F. Carlson Co., 244 Main St., Albany. Estimated cost $2,000,000.

N. Y., Buffalo—Carr & Andrews, c/o Haugaard & Burnham, 185 Madison Ave., New York, Archts., will soon award contract for the construction of an apartment on Summer St., here. Estimated cost $1,000,000.

N. Y., Glen Cove—North Shore Hospital, Locust Valley, awarded contract for the construction of a hospital and nurses' home to Bunce & Jergenson, New York Ave., Huntington. Estimated cost $500,000.

N. Y., New York—Datlee Realty Corp., c/o H. Ginsberg, 220 East 42nd St., Archt., will build a 5 story apartment at Townsend Ave. and 172nd St., by day labor. Estimated cost $600,000.

N. Y., New York—A. Kay, c/o F. P. Platt & Bro., 221 West 57th St., Archts., had plans prepared for the construction of a hotel at 6th Ave. and 46th St. Estimated cost $600,000. E. E. Seelye, 101 Park Ave., is engineer.

N. Y., Perry—Village, H. J. Rowe, Supt., will receive bids until May 11 for the installation of an oil engine and pumps to replace steam equipment in pumping station.

N. Y., Rochester—R. J. Reidpath, Mutual Life Bldg., Buffalo, Archt., will soon receive bids for the construction of a 6 and 10 story office building on Broad St., for Broad Buildings Corp. Estimated cost $500,000.

N. Y., White Plains—Westchester County Board of Supervisors, Court House, is having plans prepared for the construction of a 10 story office building on Court St. Estimated cost $800,000. B. W. Morris, 101 Park Ave., New York, is architect.

O., Columbus—Dept. of Welfare, J. E. Harper, Dir., Ninth and Oak Sts., is in the market for four 150 hp. water tube boilers and stokers for State School for the Deaf.

O., Dayton—F. J. Hughes, U. B. Bldg., is having plans prepared for the construction of a 12 story apartment on Bellemonte St. Estimated cost $1,000,000.

Oklahoma — Arkansas Power Co., Boyle Bldg., Little Rock, Ark., has made application to the State Drainage Commission for permit to construct a hydro-electric project on the Little River in McCurtain County. Estimated cost approximately $3,000,000. Engineer not announced.

Pa., Philadelphia—Forty Third & Locust Street Building Co., c/o P. M. Julian, 823 15th St., N.W., Washington, D. C., Archt., awarded contract for the construction of a 9 story apartment, here, to R. P. Whitty Co., Union Trust Bldg., Washington, D. C. Estimated cost $1,700,000.

Pa., Philadelphia — General Electric Co., Witherspoon Bldg., will receive bids until Apr. 22, for the construction of building 9, 10 and 11 at Elmwood Ave. and 68th St. Estimated cost $1,500,000. Harris & Richards, Drexel Bldg., are architects.

Tenn., Dunlop—The Dunlop Furniture Co., is in the market for one 200 hp. or two 100 hp. furnace type boilers, etc.

Tex., San Angelo—West Texas Utilities Co., Abilene, plans to expend $800,000 for generating equipment including steam turbo-generator, 6250 kva. and battery of 3 steam boilers, for plant here. Private plans.

Tex., Taylor—City Commission is having preliminary plans prepared for improvements to waterworks including pumping equipment, mains, etc. Estimated cost $35,000.

Tex., Texarkana — J. N. Myers, Hotel Grim, has acquired a site and plans the construction of a 25 ton ice plant and 100 ton cold storage plant. Estimated cost $75,000. Private plans.

Wash., Seattle—Puget Sound Power & Light Co., A. W. Leonard, Pres., Stuart Bldg., plans to expend $4,000,000 during 1926 for the construction of an interurban and stage terminal depot and service building, also increasing capacity of the Baker River hydro-electric plant from 40,000 to 50,000 hp.

Wis., Green Bay—City, W. L. Kerry, Clk., will readvertise for bids for a 1,000 g.p.m. turbine centrifugal pump with 150 hp. motor for Shawano Ave. pumping station. Former bids rejected.

B. C., Merritt—City, F. S. Gay, Clk., is having plans prepared for additions to power plant and extensions to waterworks including 200,000 gal. reservoir, etc. Estimated cost $35,000.